

# For Reference

---

**NOT TO BE TAKEN FROM THIS ROOM**

# For Reference

---

NOT TO BE TAKEN FROM THIS ROOM

Ex libris  
UNIVERSITATIS  
ALBERTAENSIS





Digitized by the Internet Archive  
in 2019 with funding from  
University of Alberta Libraries

<https://archive.org/details/Batycky1966>









Thesis  
1966(F)  
# 5

THE UNIVERSITY OF ALBERTA

PIPELINE FLOW CHARACTERISTICS OF THIXOTROPIC FLUIDS

BY

JIMMY P. BATYCKY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE  
DEGREE OF MASTER OF SCIENCE

IN  
CHEMICAL ENGINEERING

FACULTY OF ENGINEERING  
DEPARTMENT OF CHEMICAL AND PETROLEUM ENGINEERING

EDMONTON, ALBERTA

SEPTEMBER, 1966



UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled PIPELINE FLOW CHARACTERISTICS OF THIXOTROPIC FLUIDS by Jimmy P. Batycky in partial fulfillment of the requirements for the degree of Master of Science in Chemical Engineering.



### ACKNOWLEDGEMENTS

The author gratefully acknowledges the guidance of Dr. R. A. Ritter under whose supervision this investigation was carried out.

Acknowledgement is also given to the Computing Centre at the University of Alberta for the assistance they offered during the course of this investigation.

The financial support received from the National Research Council of Canada and the University of Alberta is also gratefully acknowledged.





## ABSTRACT

A computer program was developed to calculate the change in pressure that a thixotropic fluid, under conditions of laminar flow, experiences while flowing along a pipe. Calculation of the total pressure drop in a selected length of pipe at various times after start-up led to a demonstration of its transient nature.

Shear stress decay data were interpolated and integrated to yield radial incremental flow rates corresponding to a specified total - thus satisfying an over-all volumetric flow rate balance. The incremental flows were bounded by streamlines which were allowed to adjust radially as flow proceeded down the pipe. This movement of streamlines enabled maintenance of the constraint requiring that no fluid cross a streamline - hence sustaining each individual flow rate at a constant value. The movement of fluid radially accommodated its thixotropic characteristic; that is, the shear rate and consequently the velocity exhibited at any point was dependent on both the length of time that a filament of liquid had undergone shear and the shear stress that was applied to it.

By assuming that radial flow was small in comparison to longitudinal flow at any position in the pipe, the shear stress profile was approximated as linear across the flow diameter. This allowed direct calculation of the pressure drop gradient from the wall shear stress. Integration of



this gradient for each selected shear duration at a constant flow rate (from start-up to steady state) yielded transient values of line pressure drop.

Using the same flow durations at three or four volumetric flow rates, a curve representing the change in pressure drop with flow rates was plotted at each time after start-up. Then a pump characteristic of pressure drop versus flow rate was superimposed. Intersection of this curve by each of the previous ones characterized a transient response of flow rate and of pressure drop. The exact response could be controlled by substituting various pumps on the same plot.



TABLE OF CONTENTS

LIST OF FIGURES	ii
INTRODUCTION	1
LITERATURE SURVEY	3
1. Introduction to Rheology	3
2. Generalized Pressure Drop Calculation	7
3. A Mathematical Description of Thixotropy	11
A THEORY OF THE FLOW OF A THIXOTROPIC FLUID	19
PROCEDURE	27
RESULTS AND DISCUSSION OF RESULTS	48
CONCLUSION	57
NOMENCLATURE	59
BIBLIOGRAPHY	61
APPENDIX 1: NUMERICAL TECHNIQUES	1-1
APPENDIX 2: USE OF LAGRANGIAN INTERPOLATION	2-1
APPENDIX 3: COMPUTER PROGRAMS	3-1
APPENDIX 4: SAMPLE COMPUTER OUTPUT	4-1





LIST OF FIGURES

Figure Number	Title	Page
1	SIMPLE SHEAR	3
2	TYPES OF RHEOLOGICAL BEHAVIOR	5
3	SHEAR STRESS DECAY CURVES	13
4	SHEAR STRESS GROWTH CURVES	15
5	VELOCITY PROFILES FOR THIXOTROPIC FLOW	20
6	FLUID FLOW PROPERTIES	29
7	FLUID FLOW PROPERTIES	30
8	VELOCITY INTERPOLATION SCHEMES	32
9	CALCULATION OF INITIAL FLOW PROFILE	35
10	CONVERGENCE OF WALL SHEAR STRESS	39
11	GENERAL CALCULATION OF A FLOW PROFILE	41
12	SELECTION OF LENGTH INCREMENTS	44
13	PIPE SEGMENTATION	45
14	OVERALL COMPUTATIONAL PROCEDURE	47
15	VARIATION OF PRESSURE GRADIENT	49
16	VARIATION OF PRESSURE GRADIENT	50
17	VARIATION OF PRESSURE GRADIENT	51
18	PIPE FLOW PROFILES	53
19	PIPE FLOW RESPONSE	54
1-1	THE GOLDEN SECTION	1-5
1-2	TWO EXPERIMENTS WITH GOLDEN SECTION	1-6
1-3	REGULI-FALSI SEARCH	1-7
2-1	INTERPOLATION GRID	2-2



## INTRODUCTION

The design of pipelines for the transport of fluids requires an accurate prediction of pump power requirements. The magnitudes of pressure drops needed to initiate and to maintain flow, besides depending on such factors as pipe diameter and volumetric flow rate, are also a function of the rheological properties of the fluids.

Most fluids are easily described, in a rheological sense, through mathematical approximations(1). This permits the use of a simple calculation in arriving at a predicted value of pressure drop. The pressure drop, however, may be required at a number of flow rates, or the rheological data may not be readily approximated, or even the geometric configuration of the flow conduit may necessitate excessive calculation. Because of these complexities either a digital or an analog computer is then required both to reduce the calculation time and to effectively institute the applicable numerical techniques as is illustrated by Auld and Ritter (2).

A fluid which exhibits a marked variation in rheological behavior, concurrent with the duration of flow, constitutes an even more complex system. In the case of thixotropy, the fluid experiences a breakdown in structure so that pressure head requirements decrease with time while the volumetric flow rate builds up to the designed value (3,4,5). It may take days, however, to attain a suitable flow rate. Therefore, the



criterion of such design is to accrue an acceptable flow in as short a time as possible through a change in pipe diameter and pump characteristics.

Once again, the representation of rheological properties poses a problem. While the mechanisms of thixotropy have been investigated(6 - 10), the proposed constitutive equations cannot be applied to the prediction of flow phenomena in pipes. This results from either the inappropriate choice of parameters or the lengthy computer calculations that would be associated with the retrieval of the necessary information. Therefore, it is proposed that the segment of data made up of shear stress decay curves are sufficiently accurate.

Previous design attempts(3,11,12) have yielded only qualitative, or at best semi-quantitative, predictions of the flow behavior. With the aid of simplifying assumptions, this thesis presents a rigorous treatment of thixotropy in pipeline flow.





## LITERATURE SURVEY

### 1. Introduction to Rheology

Rheology, "the science of deformation and flow"(1), involves study of movement of all forms of matter. A mathematical representation of flow behavior extends from the concept of a Newtonian fluid, through a spectrum of material, until reaching that of a Hookean - elastic solid. A description of rheological properties within these bounds is approached from either end depending on the nature of the system. Here, the representation of the properties of thixotropy is illustrated by beginning with a Newtonian-type fluid.

Newton's Law of Viscosity is best visualized by considering the flow of an incompressible fluid between two parallel plates(13) as in Figure 1; the bottom plate remains fixed while the top plate moves with a constant velocity  $V$ . Under steady-state flow, the velocity between the two plates

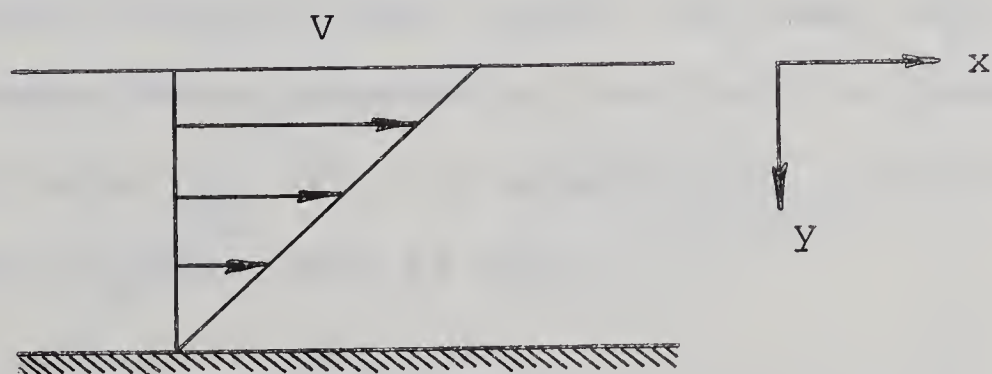


FIGURE 1





is found to be linearly distributed. For a Newtonian fluid, the force per unit area of plate required to maintain a constant velocity is proportional to the ratio of the velocity and the plate separation. This constant of proportionality is defined as Newtonian viscosity. Defining  $\tau$ , the shear stress, as the reaction force per unit area, then

$$\tau = \frac{\mu}{g_c} \left( - \frac{dv}{dy} \right) \quad (1)$$

where

$\tau$  is the shear stress,  $\text{lb}_f/\text{ft}^2$

$dv/dy$  is the shear rate,  $\text{sec}^{-1}$

$\mu$  is the viscosity,  $\text{lb}_m/\text{ft} \cdot \text{sec}$

and  $g_c$  is a dimensional conversion factor,  $\text{lb}_m \text{ft} / \text{lb}_f \text{sec}^2$ .

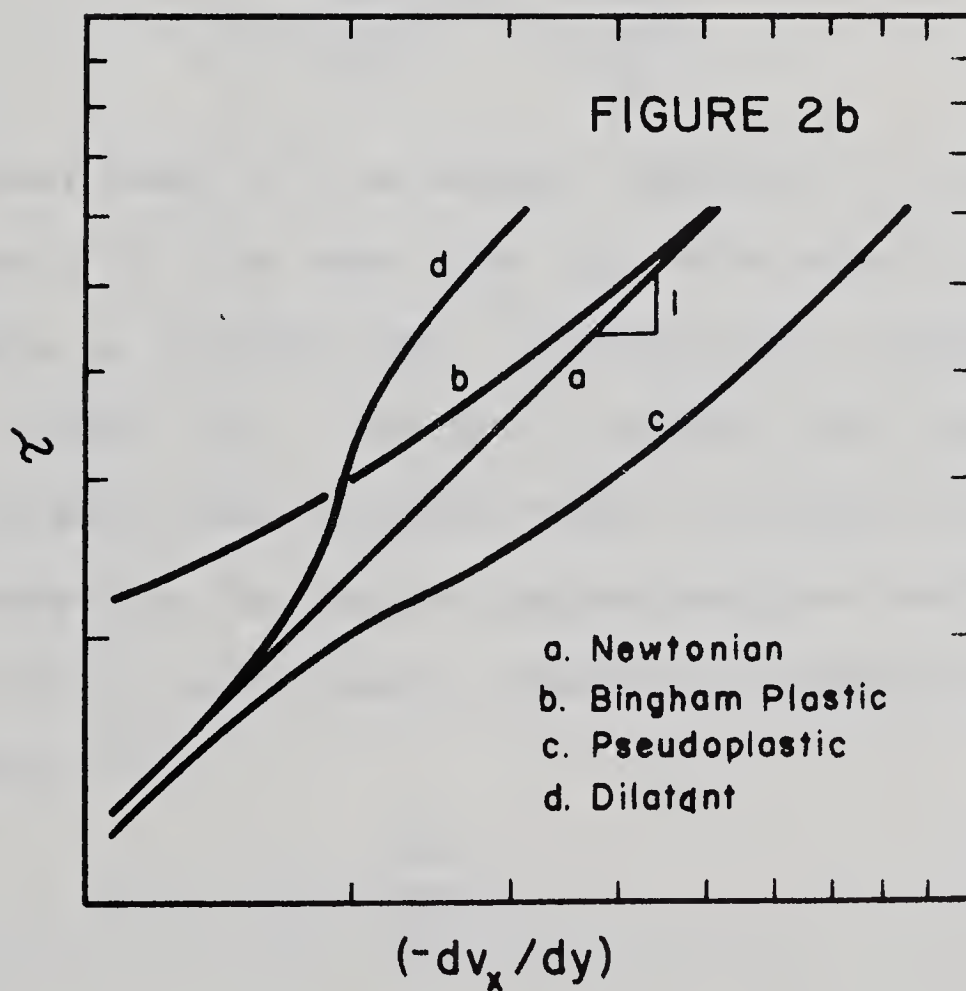
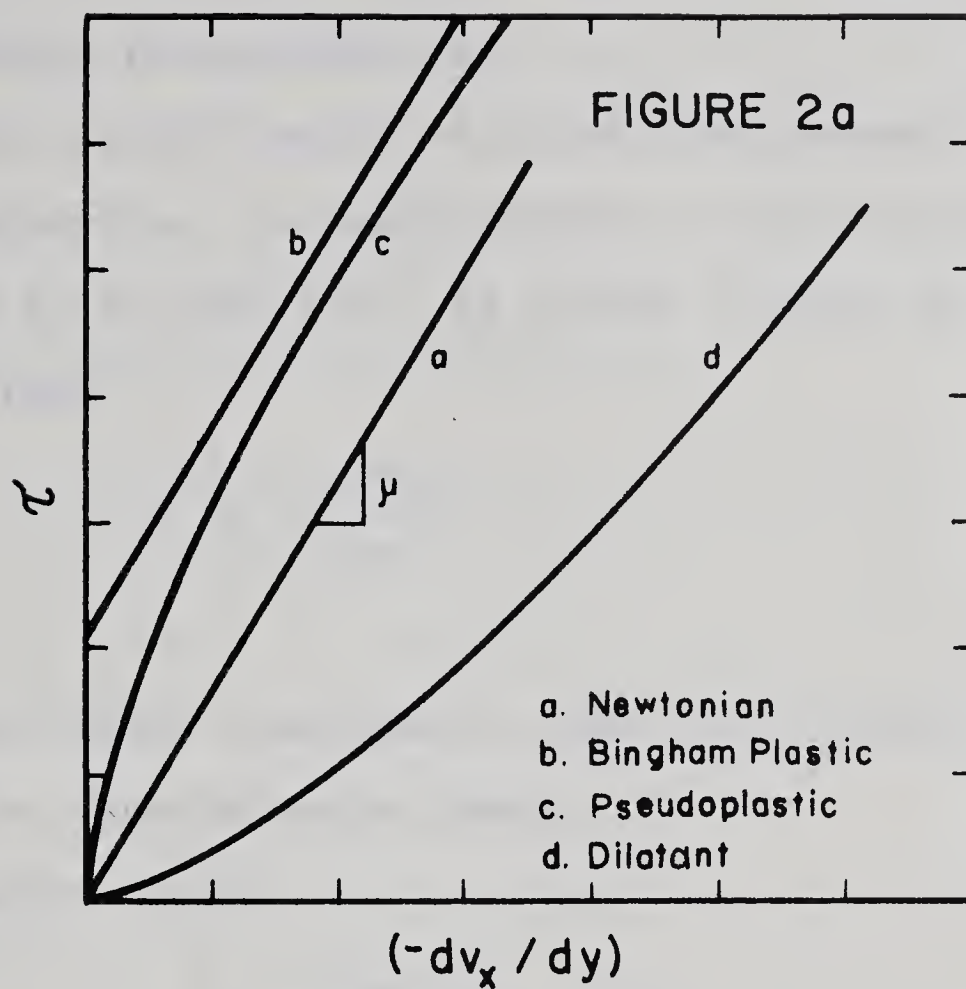
A plot of  $\tau$  versus  $dv/dy$  is then a straight line with a slope of  $\mu$  on arithmetic paper, and a straight line with a slope of unity on logarithmic coordinates. These are pictured in Figures (2a) and (2b) respectively.

Some fluids, known as Bingham plastics, exhibit a linear relationship between shear stress and shear rate but only when the shear stress exerted by the fluid is greater than a limiting value  $\tau_y$ . If  $\tau$  is less than  $\tau_y$ , there is no movement and the shear rate is zero.

$$(\tau - \tau_y) = \frac{\mu'}{g_c} \left( - \frac{dv}{dy} \right) \quad (2)$$

describes the fluid's flow properties when  $\tau \geq \tau_y$ .









When the limiting value of shear stress is zero, equation (2) becomes equivalent to equation (1).

A third classification of fluid flow properties is known as pseudoplastic. An approximation to this type, set out by Ostwald and by de Waele(14), is called a power-law fluid, which has the form

$$\tau = K \left( - \frac{dv}{dy} \right)^n \quad (3)$$

where

K is the fluid consistency index,  $\text{lb}_m/\text{ft}(\text{sec})^{2-n}$  and n is the flow behavior index.

Rewriting equation (3) as

$$\tau = K \left( - \frac{dv}{dy} \right)^{n-1} \left( - \frac{dv}{dy} \right)$$

it is easily seen that if n is unity, equation (1) is restated. However, if n is less than one, the shear stress-shear rate curve is concave down, representing a pseudoplastic as in Figure (2a). Setting n greater than one, equation (3) approximates the dilatant fluid of Figure (2).

The foregoing rheological approximations represent almost all fluids in which shear stress is a function of shear rate alone, i.e.

$$\tau = \phi_1 \left( - \frac{dv}{dy} \right) \quad (4)$$





No consideration has been given to shear stress-shear rate dependence on any other variables, namely time and temperature. It has merely been illustrated that a Newtonian fluid acts as a limiting condition of the other two fluid types.

## 2. Generalized Pressure Drop Calculations

Certain assumptions are generally made before calculating the pressure drop associated with flow in a circular conduit. Without reference to rheological properties, the assumptions are as follows:

1. The flow is at steady state.
2. The fluid is incompressible.
3. The flow is isothermal.
4. Entrance conditions are neglected.
5. The slip at the wall is negligible.

The relationship between pressure drop and shear stress in a pipe is found by evaluating a force balance on a cylindrical element of fluid. The cylindrical surface is positioned about the center-line of flow. The result is given as

$$\left(\frac{\Delta P}{L}\right)_r = \frac{2\tau}{r} \quad (5)$$

where

$(\Delta P/L)_r$  is the pressure drop gradient,  $\text{lb}_f/\text{ft}^2/\text{ft}$   
of pipe

and  $\tau$  is the shear stress,  $\text{lb}_f/\text{ft}^2$  at  
 $r$ , the radius of the cylinder, ft.



By extending the cylinder radius  $r$  to that of the pipe  $R$ , the shear stress  $\tau$  becomes the wall shear stress  $\tau_w$ . Then, the force balance gives,

$$\left(\frac{\Delta p}{L}\right) = \frac{2\tau_w}{R} \quad (6)$$

If no radial pressure gradient exists, the left hand sides of equations (5) and (6) are equal. This requirement is satisfied when the fluid is incompressible, inelastic and non-thixotropic and when the flow is fully developed. The following relationship is then valid.

$$\frac{\tau}{\tau_w} = \frac{r}{R} \quad (7)$$

Once shear stress-shear rate data have been made available in the form of an equation of state, i.e.

$$\left(-\frac{dv}{dr}\right) = \phi_2(\tau) \quad (8)$$

where  $\phi_2$  is the inverse of function  $\phi_1$  from equation (4), the velocity profile and the volumetric flow rate can be evaluated. The velocity at any radius in the pipe is obtained by integrating the shear rate along the radius:

$$V_r - V_R = \int_R^r \left(\frac{dv}{dr}\right) dr$$

or

$$V_r = \int_r^R \left(-\frac{dv}{dr}\right) dr \quad (9)$$



with  $V_r$  being the velocity at  $r$ , ft/sec

and  $V_R$  the velocity at the wall which is zero.

Once the pressure drop has been specified, the shear stress at the wall is given by equation (6), and hence, the shear rate is defined as a function of radius by equations (7) and (8).

The volumetric rate of flow is found by integrating the velocity profile over the area of flow:

$$\begin{aligned} Q &= \iint_A V_r dA \\ &= 2\pi \int_0^R V_r r dr \end{aligned} \quad (10)$$

where  $Q$  is the volumetric flow rate,  $\text{ft}^3/\text{sec}$ .

The average velocity is given by:

$$\begin{aligned} V_A &= \frac{\iint_A V_r dA}{\iint_A dA} \\ V_A &= \frac{Q}{\pi R^2} \end{aligned} \quad (11)$$

Equations (6) to (11) represent a description of the flow. To this point the equations are independent of fluid properties, with the exception of (7) and (8) which do not incorporate thixotropic behavior.

Since the purpose of these equations is to predict the pressure gradient associated with a given flow rate, it





should be noted that, in general, an iterative procedure is necessary. This involves selecting values of pressure drop and then comparing the flow rates obtained with the given value until the difference between them falls within a certain tolerable error limit.

A criterion in defining laminar flow has been advanced by Metzner and Reed(16) in the form of a Generalized Reynolds number. It takes the form

$$Re = \frac{D V \rho}{g_c \mu_A} \quad (12)$$

where

$\rho$  is the fluid density,  $lb_m/ft^3$ ,

$D$  is the diameter of the pipe, ft,

$V$  is the average velocity, ft/sec

and  $\mu_A$  is the apparent viscosity,  $lb_f \text{sec}/ft^2$ .

By manipulation of equations (6) to (11), as per references 14 to 16, the shear stress can be related to an apparent shear rate in the form of a power-law expression:

$$\left( \frac{D \Delta P}{4 L} \right) = K' \left( \frac{8V}{D} \right)^{n'} \quad (13)$$

where  $K'$  and  $n'$  are constants which can be arrived at over a series of flow rates for a particular fluid. Then the apparent viscosity is,

$$\mu_A = K' \left( \frac{8V}{D} \right)^{1-n'} \quad (14)$$



Brodkey(17) has verified that the ratio between the apparent shear stress and the apparent shear rate is also correct:

$$\mu_A = \frac{\frac{D \Delta P}{4L}}{\frac{8V}{D}} \quad (15)$$

The laminar flow range is then defined in terms of Re and n'. Shaver and Merrill(18) have defined this functionality graphically. They have experimentally found that if n' decreases from unity to 0.53, the Reynolds number can be greater than 3000 before the flow experiences any turbulent fluctuations.

The generalized equations which have been presented are functional in computing the pressure drop of any time-independent rheologically-complex fluid provided that an equation of state is present in an integrable form.

### 3. A Mathematical Description of Thixotropy

A fluid which exhibits thixotropic properties is one in which shear stress, at constant temperature, is not a unique function of shear rate. Thus, the relationship represented in equation (4) is not applicable. A model describing thixotropy will therefore be developed, in an abbreviated form, as it was proposed by Ritter(7).

Thixotropic fluids can be physically represented by a large network structure of loosely-bonded macromolecules suspended in a Newtonian solvent. Then the stress generated



under shear originates from the resistance offered by the structure as well as from the contribution of the Newtonian solvent. The total shear stress is given by

$$\tau = \tau_s + \tau_\mu \quad (16)$$

where  $\tau_s$  is the structural component of shear stress,  $\text{lb}_f/\text{ft}^2$   
 $\tau_\mu$  is the Newtonian component,  $\text{lb}_f/\text{ft}^2$ .

As shearing progresses at a constant rate, the consistency of the fluid decreases, i.e. the shear stress falls as in Figure 3. Physically, this decay results from the simultaneous occurrence of two phenomena; the breakage of the network links and the alignment of the filaments. It has been further contended by Ritter that the rate at which shear stress decreases is dependent only on the duration of shearing and not on the shear rate. By considering the structural decay as a first-order irreversible reaction the following equation for the rate of change of structural stress results:

$$\frac{d\tau_s}{dt} = -k_A \frac{\tau_s}{t} \quad (17)$$

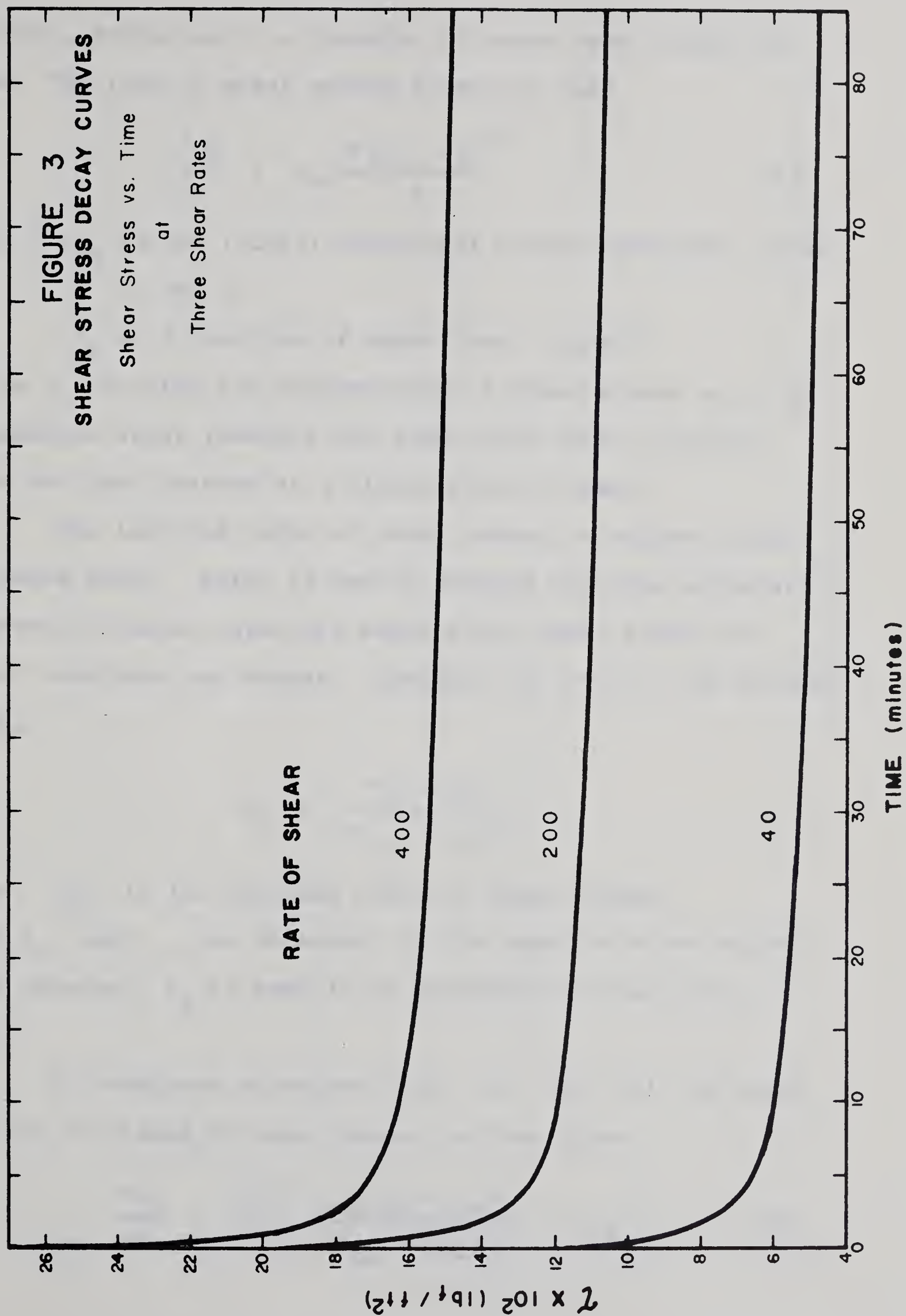
where  $k_A$  is a constant

and  $t$  is the duration of shearing, min.

Following a decrease in shear rate, a reconstructive force is encountered. This force, which is the same molecular attraction initially responsible for the structural stress component, is continually creating linkages. Ritter has attributed to the network growth, properties of a second-order











reaction, rendering it a function of shear rate as well as time. The rate of shear stress growth is then,

$$\frac{d\tau_s}{dt} = k_B \frac{(\tau_{s0} - \tau_s)^2}{t} \quad (18)$$

where  $\tau_{s0}$  is the initial structural stress component, given  $\tau_s$  and  $t$ ,

and  $k_B$  is a function of shear rate,  $lb_f/ft^2$ .

Figure 4 indicates the predominance of shear stress build-up encountered after lowering the shear rate once a limiting value had been reached at a higher rate of shear.

The limiting value of shear stress is reached after prolonged shear. Here, it can be assumed that the structural build-up and decay rates are equal since shear stress no longer undergoes any change. Equating (6) and (7) and solving for  $k_B$ ,

$$k_B = \frac{k_A (\tau_{s\infty})}{(\tau_{s0} - \tau_{s\infty})^2}$$

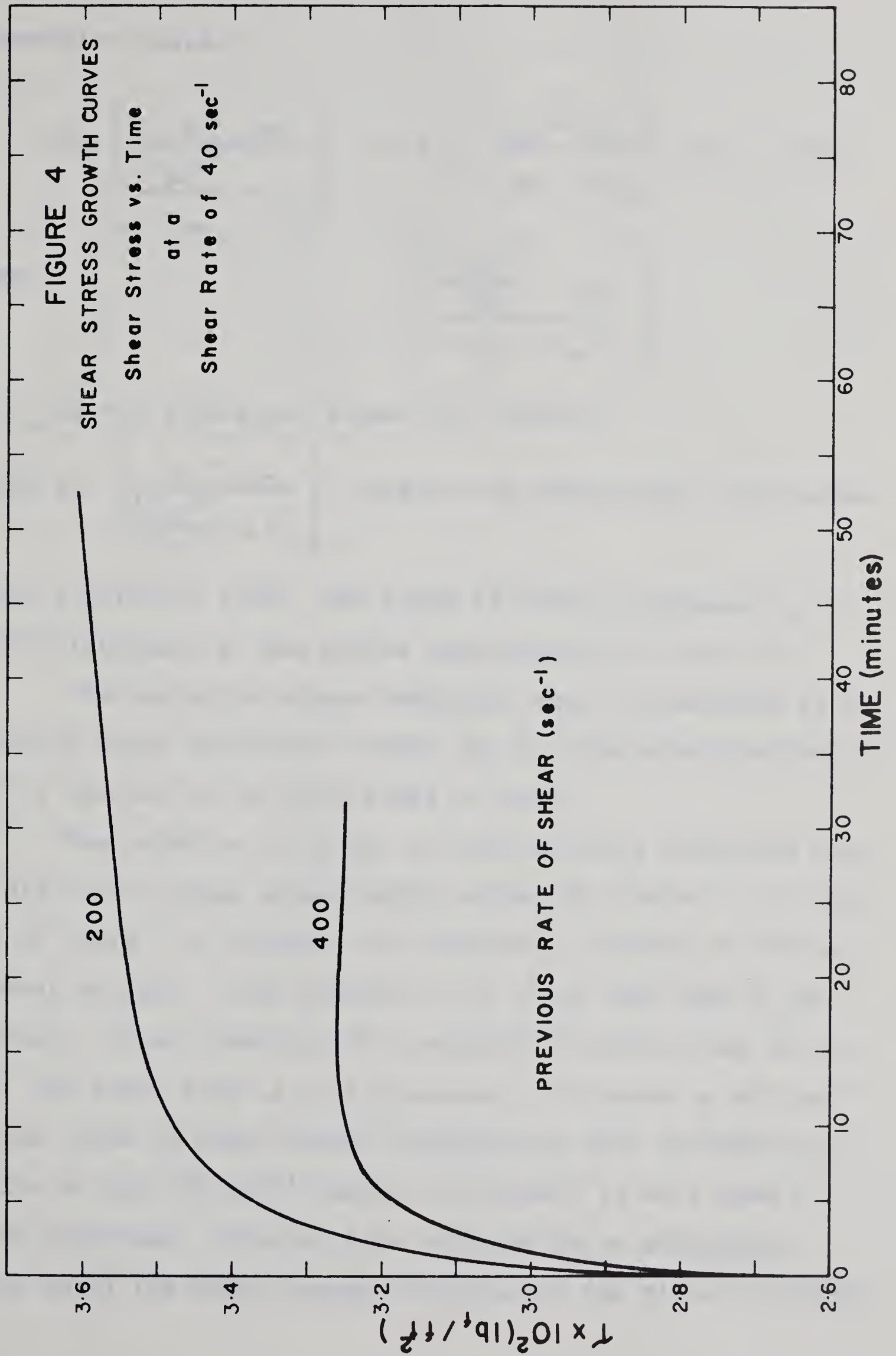
where  $\tau_{s\infty}$  is the limiting value of shear stress.

Since  $\tau_{s0}$  and  $\tau_{s\infty}$  are dependent on the shear rate and since  $k_A$  is constant,  $k_B$  is seen to be dependent on the rate of shear.

By combining equations (16), (17) and (18) the overall rate of change of shear stress is then given,

$$\frac{d\tau_s}{dt} = \frac{k_A}{t} \left[ \frac{\tau_{s0} (\tau_{s0} - \tau_s)^2}{(\tau_{s0} - \tau_{s\infty})^2} - \tau_s \right] \quad (19)$$









Integration yields

$$\log \left[ \frac{\frac{\tau_s - \tau_{s\infty}}{(\tau_{s0})^2}}{\frac{\tau_{s0}}{\tau_{s\infty}} - \tau_s} \right] = -k_A \left[ \frac{\tau_{s0} + \tau_{s\infty}}{\tau_{s0} - \tau_{s\infty}} \right] \log t - \log C \quad (20)$$

where

$$C = \left[ \frac{\frac{(\tau_{s0})^2}{\tau_{s\infty}} - \tau_{s1}}{\tau_{s1} - \tau_{s\infty}} \right]$$

and  $\tau_{s1}$  is the structural stress at 1 minute.

A plot of  $\left[ \frac{\frac{\tau_s - \tau_{s\infty}}{(\tau_{s0})^2}}{\frac{\tau_{s0}}{\tau_{s\infty}} - \tau_s} \right]$  versus  $t$  on logarithmic coordinates

yields a straight line. The slope is used to evaluate  $k_A$ , and the intercept at one minute determines the value of  $C$ .

The Newtonian stress component must be evaluated at a condition where structural growth can be considered ineffective. This is carried out at high rates of shear.

The behavior of  $k_B$  can be qualitatively explained with the aid of the shear stress decay curves of Figure 3. An element of fluid, for example, is continually sheared at 200 reciprocal seconds. From equation (19) it is seen that  $k_B$  is constant. After shearing for a selected duration, say 30 minutes, the shear rate is instantaneously increased to 400  $\text{sec}^{-1}$ . The new value of shear stress accompanying this increase will not lie on the 400  $\text{sec}^{-1}$  curve, but rather, it will show a slight overshoot. This will be followed by an adjustment period until the shear stress exhibited by the fluid is coinci-





dent with the  $400 \text{ sec}^{-1}$  decay curve. The overshoot occurs because the rate of structural growth, and therefore the number of linkages, is greater at the lower shear rate than at the higher rate. The larger number of linkages encountered offer a greater resistance than would be ordinarily anticipated through constant shearing at  $400 \text{ sec}^{-1}$ , and hence, the higher shear stress. The values of  $k_B$  and the structural growth rate at the top of the overshoot, according to equation (18) and (19), are then given by the values of  $\tau_{s0}$  and  $\tau_{s\infty}$  corresponding to the shear rate.  $\tau_s$  will then decrease until its value is consistent with the applied rate of shear. The adjustment periods that were experimentally obtained by Ritter following instantaneous decreases in shear rate are shown in Figure 4.

A similar kinetic treatment of thixotropy was carried out by Denny and Brodkey(10). Their approach differed from Ritter's in that they assumed that the fluid was a mixture of broken and unbroken structure. Ritter, on the other hand, felt that the structure could undergo several cleavages, indicating a series of reactions, before arriving at the completely broken structure. Even though the latter seems more reasonable, both solutions agree quite well with the fluid's rheological behavior.

Although the initial and limiting values of shear stress are uniquely represented at each shear rate, a concept born out by Cheng and Evans(8), the preceding theory does not attempt to describe this functionality. Therefore, utilization



of the theory in the representation of fluid flow is severely handicapped. Its main implementation lies only in describing fundamental properties.

Along with a strong time dependency, the rheological properties of a thixotropic fluid are markedly affected by temperature. Besides increasing the initial and limiting values of shear stress, a decrease in temperature has the effect of making the time dependency more pronounced. In terms of the shear stress decay curves of Figure 3, they move upwards displaying increasing differences between the initial and the limiting stress. It follows that an increase to a sufficiently high temperature results in behavior that is almost Newtonian.

A final characteristic of a thixotropic fluid, with respect to its thermal properties, is illustrated when the fluid, at rest, undergoes a lowering of temperature. During the cooling, a gel forms(3,4,5,12,19). The strength of the gel is similar to the limiting shear stress of a Bingham plastic. The yield, like the consistency behavior of a thixotropic fluid, is temperature dependent such that its value decreases with increasing temperature.





## A THEORY OF THE FLOW OF A THIXOTROPIC FLUID

A qualitative understanding of the flow of a thixotropic fluid is derived from the consideration of laminar flow in a circular conduit. The entering fluid as well as that which fills the pipe has no previous shear history and in the following discussion this state will be defined as age zero. A specified flow rate is immediately attained upon the commencement of flow. Since the entrance conditions are neglected, the entering fluid assumes a fully developed profile. Equiradial streamlines are assigned at start-up as in Figure 5a. In order to maintain the incremental flow rates between streamlines at constant values, these streamlines may move radially according to the continuity equation.

As the duration of flow increases after start-up, the consistency of the fluid, because of its aging, decreases. Figure 5b shows the distribution of ages after one minute of flow at four arbitrary locations along the pipe including the entrance. The increment nearest the wall at the three downstream locations indicates a higher average velocity. In order that this incremental flow rate be constant, the streamline must move nearer to the wall. Similarly, adjustments of the other streamline positions occur.

The next time increment, illustrated in Figure 5c, depicts the next possible age and velocity distributions at the four positions in the pipe. Similarly, Figures 5d and 5e



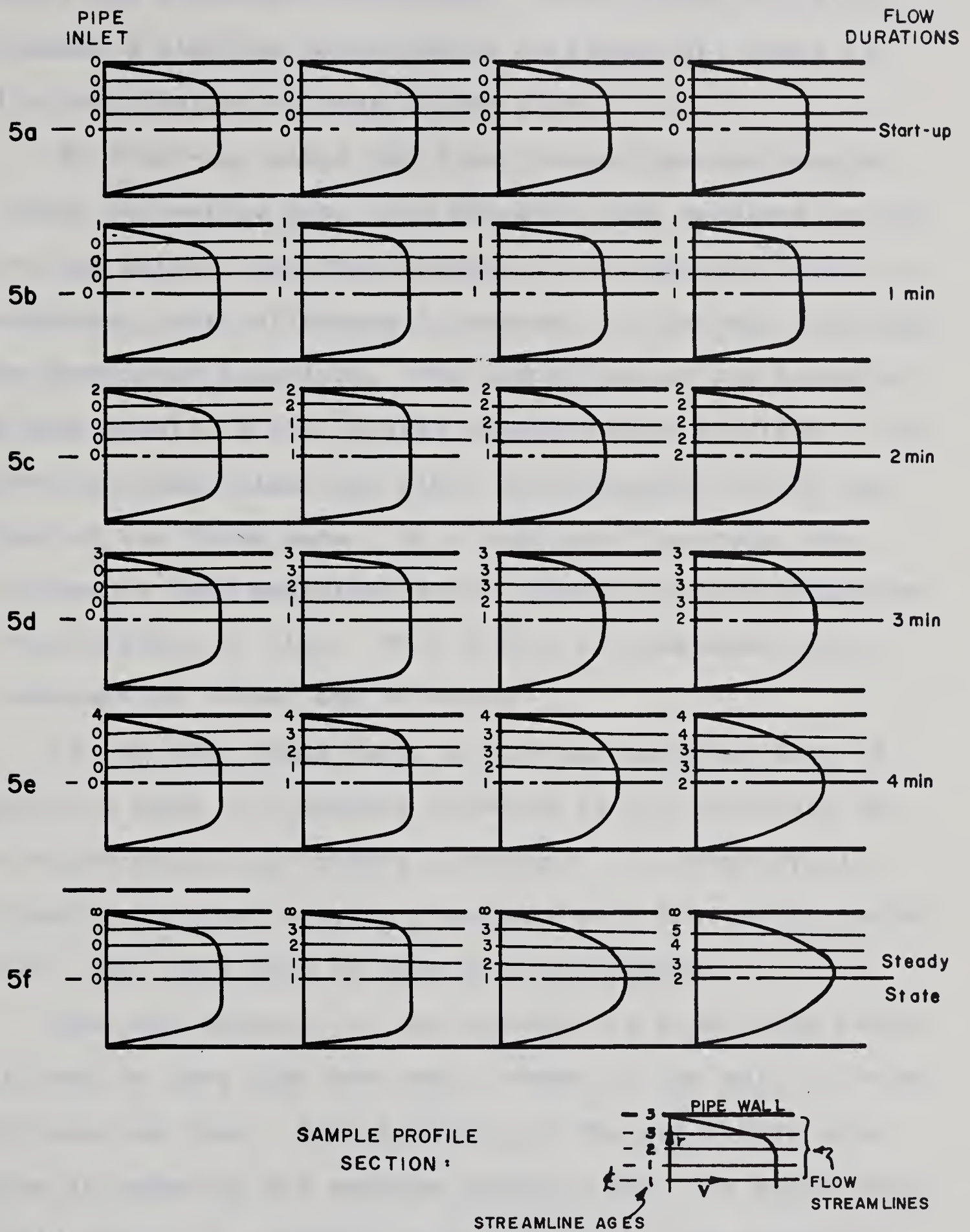


FIGURE 5 VELOCITY PROFILES FOR THIXOTROPIC FLOW





represent the subsequent conditions. Even though the flow has reached a limiting condition as in Figure 5f, there is still a distribution of ages in the pipe.

At start-up, since the fluid properties are consistent along the entire pipe, the pressure drop gradient is the same at any point. The consistency of the entering fluid in the remaining parts of Figure 5, however, is greater than that at the downstream locations. The properties of the entering fluid then result in the largest pressure drop gradient. The gradient decreases along the pipe, corresponding to the combination of the fluid ages. At a constant flow rate, the total pressure drop exhibited over a length of pipe decreases with the duration of flow. This effect is consistent with that proposed by Govier and Ritter(3).

If, on the other hand, a constant pressure drop is imposed on a pipe, a transient increase in the flow rate results as the fluid consistency decreases. Although Wyllie and Jones(5) obtained varying responses on a laboratory-scaled pipeline, they were able to draw this conclusion.

When the material in the pipeline is a gel, its yield stress must be less than the shear stress at the wall in order to initiate the flow. Deterioration of the gel occurs once the flow is underway and extends radially from the point where the yield stress is exceeded up to the wall. The necessity of a minimum pressure drop to initiate flow is easily substantiated(3,5,6,12). Since the pressure drop gradient and



hence the shear stress decays with time, no further deterioration of the gel can be envisioned. The only portion of the flow which can experience aging is the cross-section of the fluid extending from the edge of the plug-shaped gel to the pipe wall. The concept of a plug is accepted by Sellers(19). Because the plug undergoes no reduction in diameter after start-up, the change in consistency accompanying flow causes the plug to accelerate, thus allowing the streamlines to move away from it.

The shear rate in a thixotropic fluid is a function of time as well as shear stress. The functional relationship represented by equation (8) is extended to include time, i.e.

$$\left(-\frac{dv}{dr}\right) = \phi_3(\tau, t) \quad (21)$$

where  $\phi_3$  is represented by the shear stress decay curves of Figure 3.

The shear stress growth is assumed to be negligible when considering flow in a pipe. This is so for two reasons:

1. The change in shear rate experienced by an element of fluid as it travels down the pipe is small compared to the five and ten fold decreases in shear rate necessary to obtain the data presented in Figure 4. Thus, only minor changes in shear stress will be associated with changes in shear rate, and





2. Restoration to ninety percent of the final value of shear stress occurs about ten times faster than that required for a similar amount of decay.

Therefore, the shear stress data not only control but in fact describe the fluid properties under the continuous shear experienced in pipeline flow. The foregoing discussion is considered as adequate justification for the crucial assumption that the relationship between shear stress and shear rate is a unique function of time.

Equation (6) presents the relationship between pressure drop and shear stress at the wall for steady state flow. Under unsteady-state conditions, this relationship is also a good approximation since its validity can only be affected by radial flow. This is expected to be insignificant when compared with the velocity in the direction of flow. Cheng et al(11) also assumed that the shear stress profile is linear and the shear stress at the wall represents the pressure drop at that point in the pipe. Therefore equation (6) is applicable and similarly equation (5) is assumed to be correct, making the linear relationship of equation (7) represent the flow situation.

For analysis, the pipe is segmented into radial and longitudinal increments. The number of radial increments is chosen so that an increase does not affect the age distribution; the exact nature of the distribution will be mentioned





later. The size of a longitudinal increment is controlled by the error associated with the assumption of linear aging along its length. Because the rheological properties decay in a non-linear manner with duration of flow, these longitudinal increments vary in length.

The transient response of pressure drop at a constant flow rate is approached by selecting various durations of flow in the same manner as that outlined in Figure 5. For example, after five minutes of flow in a pipe which initially contained zero age material and which is fed by zero age fluid, there is a distribution of fluid ages corresponding to the duration of shear. Once the fluid which has been entering for five minutes has been volumetrically accounted for in each increment, only the original fluid that has been continually sheared for five minutes remains. The amount of aging that occurs along each increment complicates the iteration procedure for wall shear stress since the aging is related to an average of the velocities at each end. The velocity profile at the front of the increment is of course to be established in the iteration. Once the pressure drop gradient has been calculated from the wall shear stress at each increment boundary, integration over the pipe length provides the total pressure drop required at each flow duration.

Calculation of the pressure drops at three or four flow rates using common durations of flow facilitates plotting of the pressure drop as a function of flow rate at these flow



durations. However, calculation at a constant flow rate assures that the apparent shear rate is constant and therefore the assumption that the decay curves are valid may appear reasonably accurate. The points which establish a constant flow duration curve are arrived at by using individual average rates of shear. The argument that the growth restoration is both nominal and rapid must once again be relied upon.

A characteristic curve which relates pressure or suction head to a pump's capacity provides a unique value of pressure head for any given flow rate. The response of any flow after start-up can follow only this curve. The characteristic curve is then superimposed on the same coordinates as the constant flow duration curves with allowance being made for pressure losses due to a change in elevation between the pipe entrance and exit. The value of pressure drop for no flow on the pump curve enables calculation of the initial shear stress at the wall. If the fluid is in a gel condition, pumpability of the oil with this pump as well as the plug width of the gel is easily calculated. While the pump's own response is not given, it is assumed that, except for the initial seconds, pressure drop and flow rate will behave in the transient manner indicated by intersections with the constant flow duration curves.

The calculation of the pressure drop is contingent on two main assumptions:





1. The shear stress decay curves represent a unique description of the rheological properties of the fluid, and

2. Shear stress is distributed linearly across the radius of the pipe.

Finally, although it is not correct to ignore the entrance conditions, the resultant error will not affect the total pressure drop over a line of significant length.





# PROCEDURE

A computer program was written to calculate, for a constant flow rate, the transient pressure drop response. The development of this program follows.

The pipe was segmented into radial and longitudinal increments. A cross-section of pipe was divided into  $n$  radial increments, the  $i^{\text{th}}$  increment being bounded by  $r_i$  and  $r_{i+1}$ . Then the velocity at  $r_{i+1}$  was deduced from equation (9), viz.

$$V_{i+1} = \int_{r_{i+1}}^{r_i} \left( - \frac{dv}{dr} \right) dr + V_i, \quad i = 1, 2, 3 \dots, n \quad (22)$$

The boundary condition sets the velocity at the wall,  $V_{n+1}$ , equal to zero. Using the same nomenclature, the volumetric flow rate within an increment became

$$Q_i = 2\pi \int_{r_i}^{r_{i+1}} V(r) r dr \quad (23)$$

where  $V(r)$  was the velocity distribution with radius and the values of  $V_i$  at  $r_i$  were points on this profile.

The first task was to establish a method through which shear rate could be obtained for the integration of equation (22). Preparation of the data involved cross-plotting the shear stress decay curves, Figure 3, at constant durations of shear. Then shear rate became the dependent variable, making time and shear stress the independent variables. By assuming that the constant time lines described a series of



pseudoplastic fluids, and by assuming that the shear stress exhibited in the absence of a gel was zero at a zero rate of shear, the fluid properties were extrapolated from Figure 3. The fluid flow properties are shown in Figure 6 on logarithmic coordinates while near the origin they are given on arithmetic coordinates in Figure 7. A value of shear rate was readily defined at a specified quantity of shear stress and time, i.e.,

$$\left(-\frac{dv}{dr}\right) = \phi_3(\tau, t) \quad (21)$$

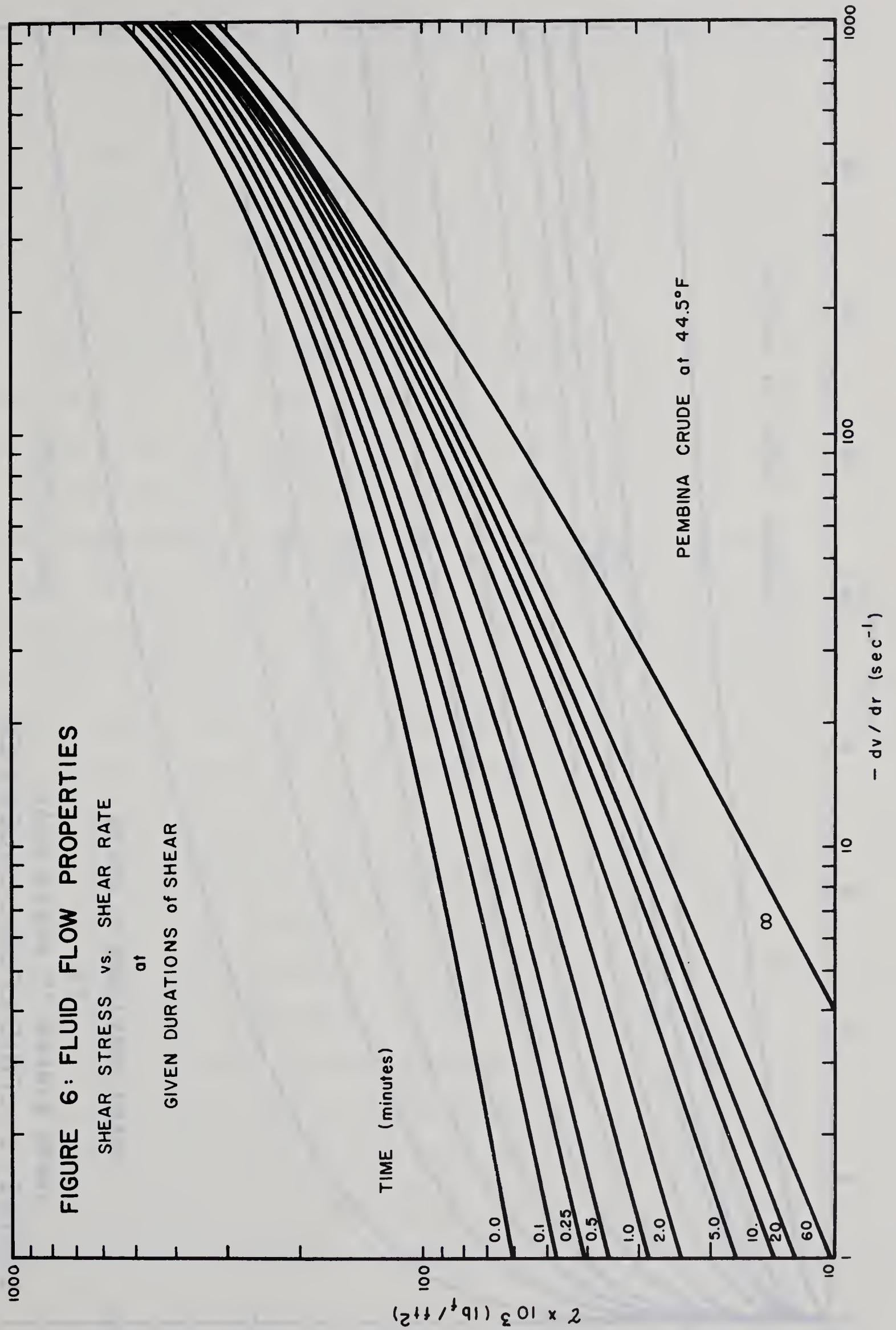
To facilitate its use in a computer program, discrete values of data were obtained from these cross-plots, and a Lagrangian Interpolation polynomial(20) (Appendix 1) was employed to provide a value of shear rate at a particular shear stress and flow duration. The interpolation polynomial proved advantageous for a number of reasons.

1. The polynomial did not alter data points, but joined them with a series of curves, or more specifically, it placed a surface between the points. An attempt to obtain a polynomial representation of the complete surface was unsatisfactory because of the inaccuracy of the approximation (based on both least-square and Chebyshev criteria with respect to the data) and because of undesirable curvatures that were superimposed.

2. The interpolation polynomial fitted only a section of the surface as required (Appendix 2) permitting a more accurate representation of rheological properties through

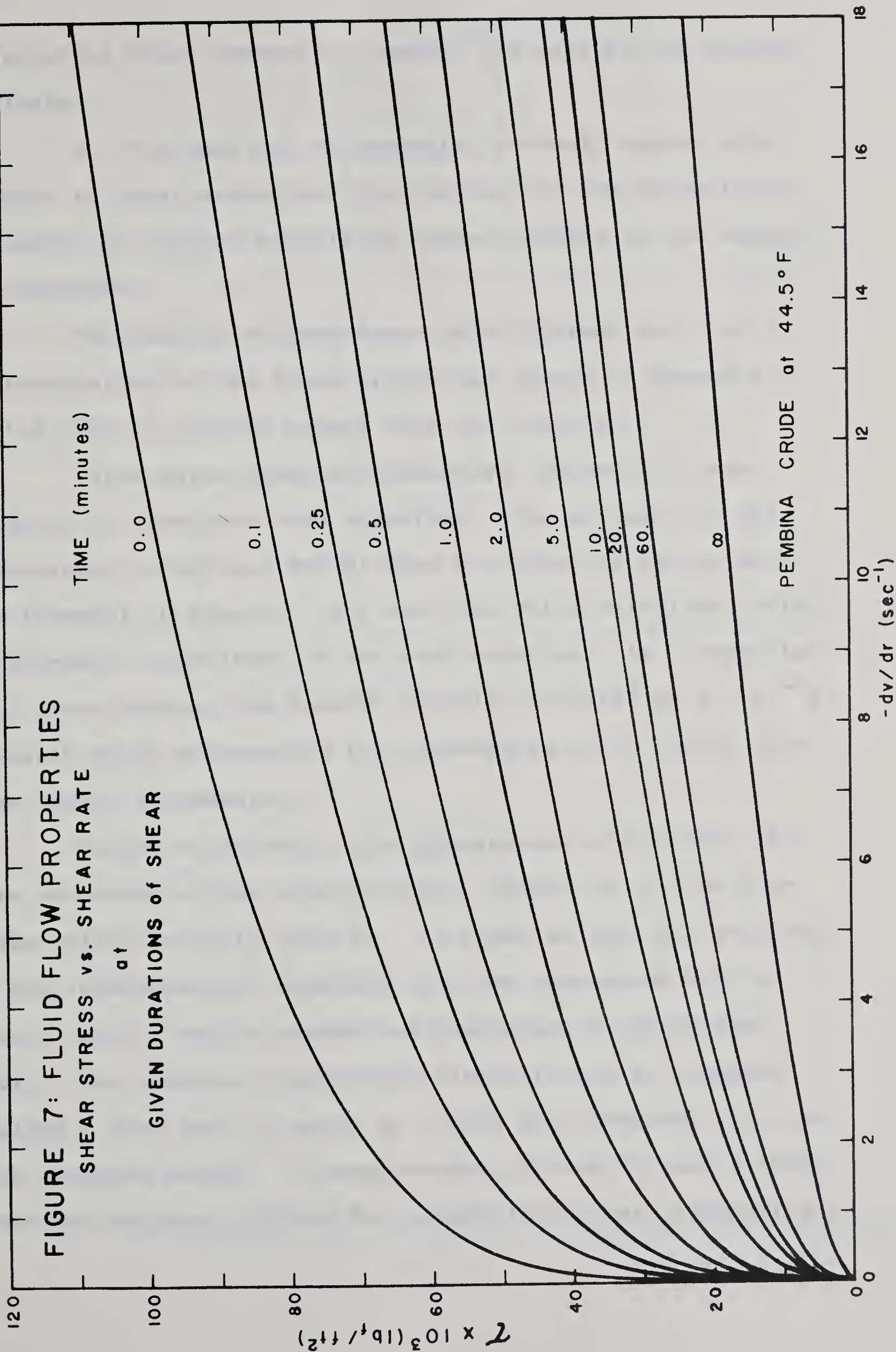














data points where necessary, leaving the rest of the surface unaltered.

3. The data were by necessity unevenly spaced with respect to shear stress and time because of the accumulation of points at regions exhibiting marked changes in the degree of curvature.

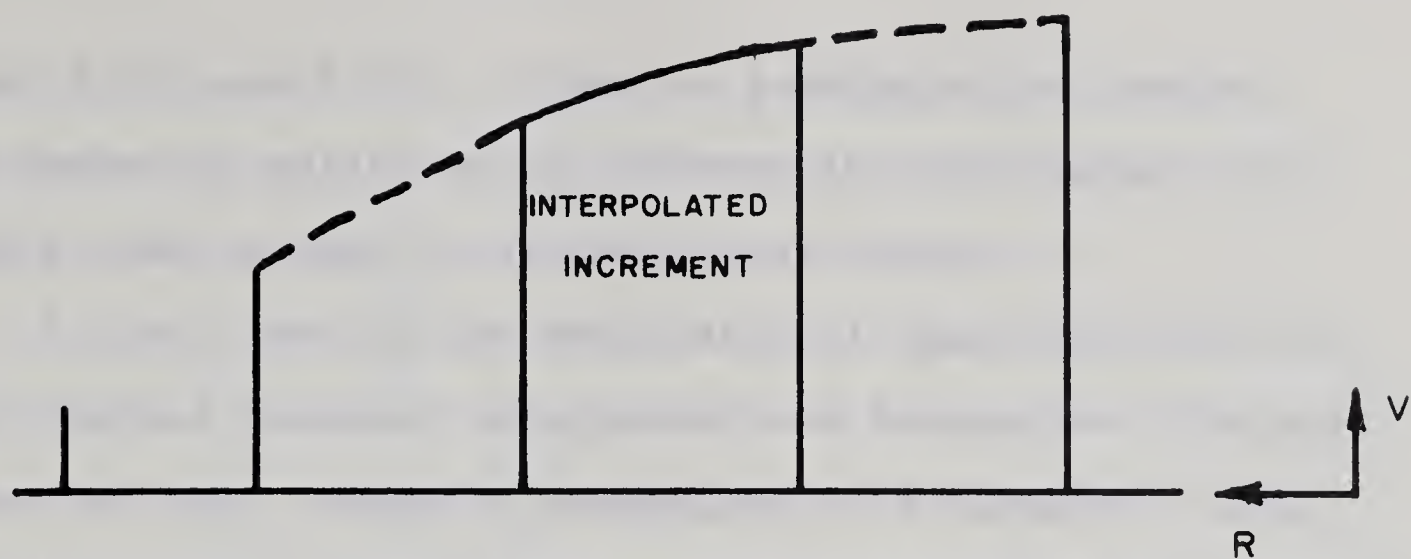
The data which were taken from Figures 6 and 7 as a representation of the fluid properties appear in Appendix 4 in the form of printed output from the computer.

Three-point Gaussian quadrature (Appendix 1) was utilized to integrate both equations. The accuracy of the integration scheme was established by comparing the value of the integral in equation (22) with the value calculated using a five-point quadrature on the same equation. At a specified wall shear stress, the maximum velocity differed by  $6 \times 10^{-5}\%$ , a result which represented the accumulated error across sixteen radial increments.

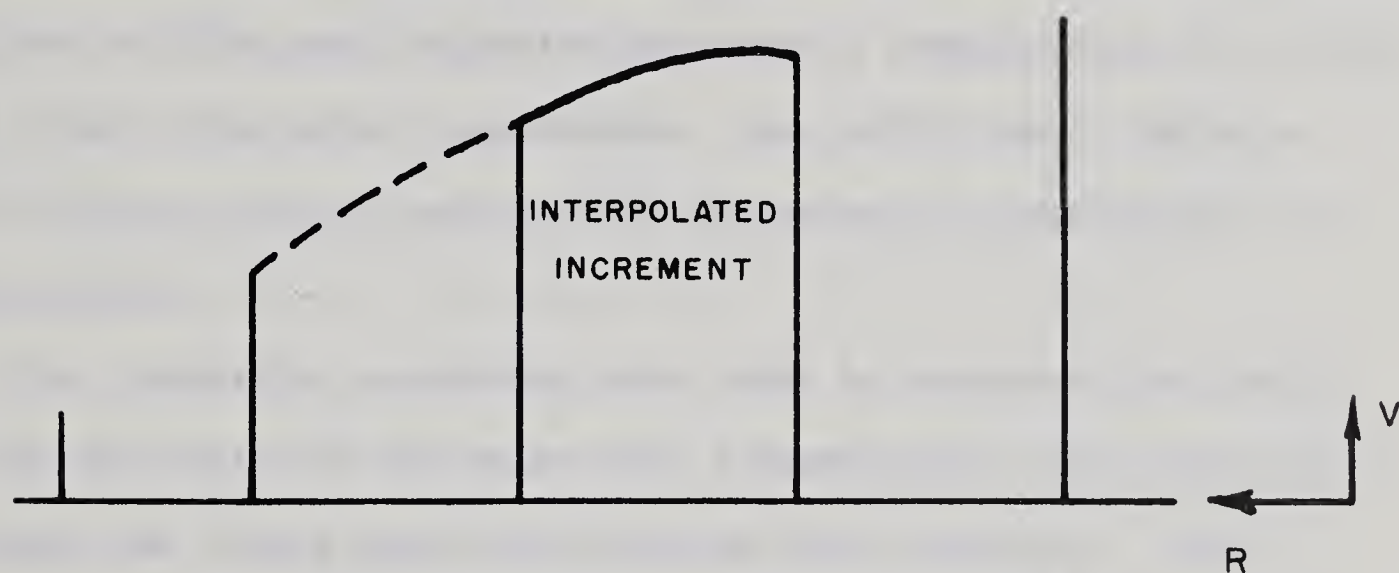
Values of velocity, for integration in equation (22) were extracted by the interpolation, Figure 8a, of the discrete valued velocity profile. In order to test the accuracy of the interpolation, equation (23) was integrated with a Newton-Cotes 17-point closed end quadrature on equispaced radii. The combined integration-interpolation as proposed yielded a flow rate in error by 0.035% when compared with the more accurate method. A second-order, Figure 8b, and a third-order end oriented, Figure 8c, interpolation were respectively



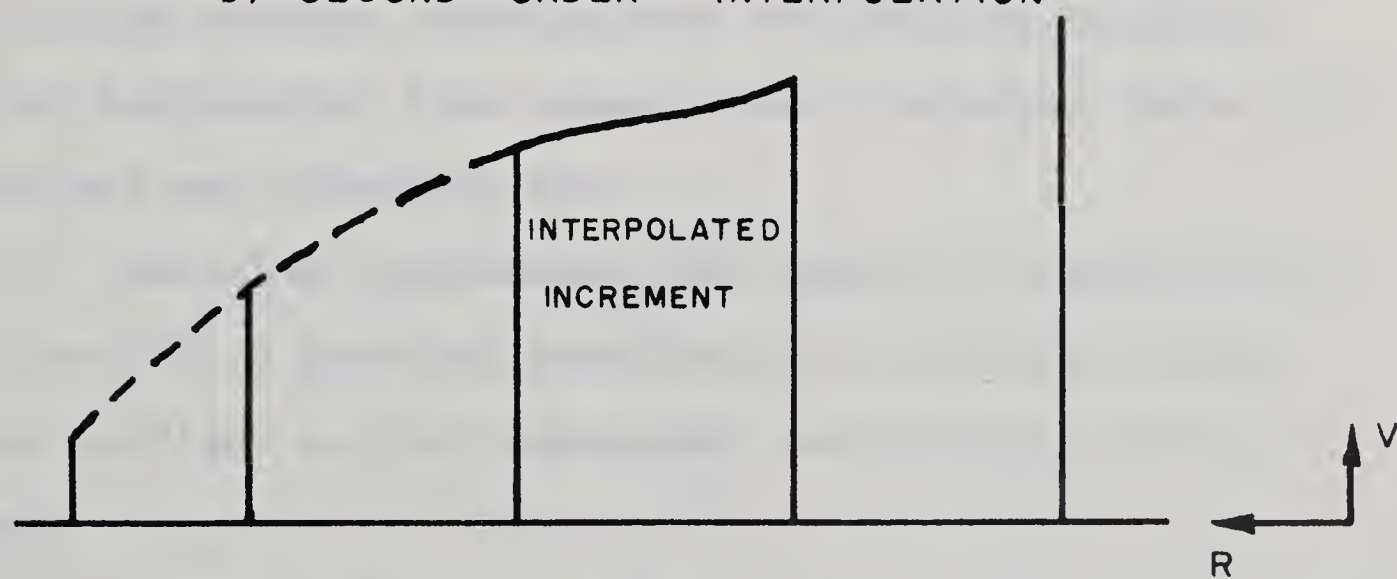




a) THIRD-ORDER INTERPOLATION



b) SECOND-ORDER INTERPOLATION



c) THIRD-ORDER END ORIENTED INTERPOLATION

FIGURE 8 VELOCITY INTERPOLATION SCHEMES





in error 0.11% and 0.20%. Since an interpolation across a larger number of points would increase the calculation time, the third-order scheme of Figure 8a was chosen.

A final test of the computational speed and accuracy of the combined Gaussian integration and Lagrangian interpolation was obtained through a comparison with Simpson's three-point integration. Given the shear stress at the wall, a flow rate error of 10% was indicated through a comparison with that given by the five-point quadrature. An additional computer time of 10% over that used by the three-point quadrature resulted as well.

An iterative procedure was used to compute the shear stress at the wall of the pipe for a particular flow rate provided that the fluid age distribution was constant. This section of the program, usually used at the pipe entrance, arrived at incremental flow rates using a selected radial distribution and was necessary for:

1. defining incremental flow rates at the beginning of the pipe with a constant entering age, assuming a fully-developed profile, so that subsequent calculations could be performed,
2. establishing the radius of a plug at a prescribed flow rate if a gel existed in the fluid (calculated a constant age zero), and
3. calculating the shear stress when a plug existed for some given duration of flow.



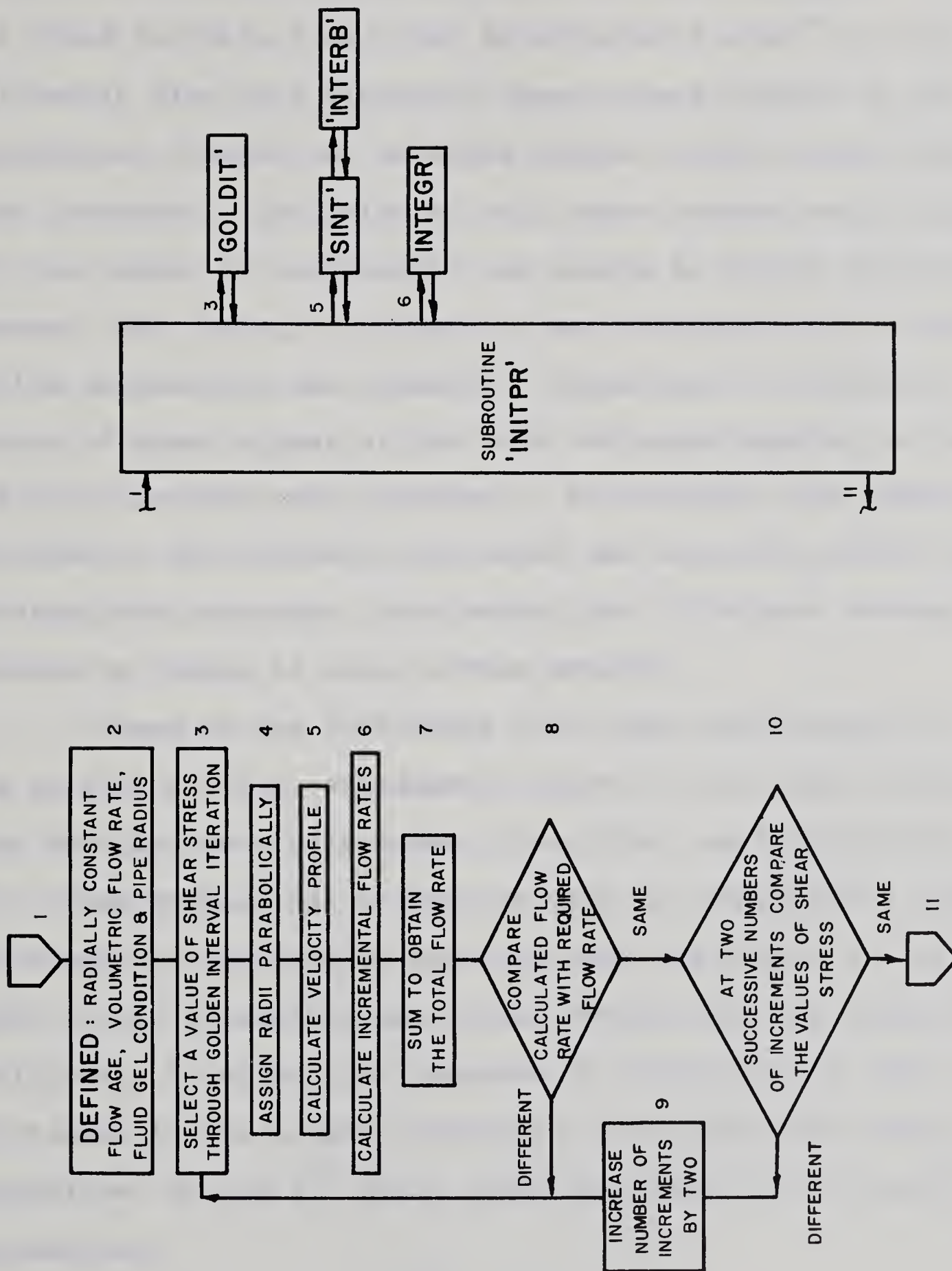
The procedure through which flow at the pipe entrance was evaluated also enabled selection of the number of radial increments. This selection was based on the change in wall shear stress obtained at different numbers of increments. Figure 9 presents a schematic representation of the computational procedure for this portion of the program. On the left is the general procedure whereas its deployment through the use of subroutines or subprograms appears on the right. The subroutines, as written in Fortran IV, appear in Appendix 3.

Golden interval iteration(22) (Appendix 1) embodied in subroutine 'GOLDIT' selected trial values of shear stress. Use of this procedure is necessary when the function does not lend itself to a more conventional convergence technique if the function is poorly behaved and convergence is impossible through a more conventional method. Since the incremental flow rates defined the mass balance within increments, it was required that they be defined accurately. Radial streamline positions were then assigned parabolically so that increment widths decreased nearer the wall where the shear rate was highest, allowing for a more uniform integration accuracy across the pipe radius. The integration of equation (22) as previously discussed was carried out in two subroutines; 'SINT' performed the integration of shear rates supplied by 'INTERB'. The total flow rate was the sum of the individual flow rates corresponding to the trial value of shear stress. Then a









a) SIMPLIFIED FLOW DIAGRAM

b) SUBROUTINE BLOCK DIAGRAM

FIGURE 9 CALCULATION OF INITIAL FLOW PROFILE



comparison with the required value of flow rate indicated whether or not the above procedure was to be repeated. It was found for this fluid that an error of  $1 \times 10^{-4}\%$  in the volumetric flow rate yielded a shear stress correct to six significant figures and accurate values of flow rates within each increment. The value of wall shear stress, while accurate at this number of increments, was liable to change upon an increase. The number of increments was increased by two and the entire calculation was repeated. Comparison of these two values of shear stress at the wall indicated whether or not a further increase was necessary. By enlarging the number of increments, the accuracy with which the velocity profile was interpolated increased, thus making the difference between successive values of shear stress smaller.

Based on the individual flow rates established in the initial profile, subsequent values of wall shear stress down the pipe were calculated. The fluid age distribution at a cross-section was related to that at the previous cross-sectional distribution by assuming that the change in velocity along a flow streamline was linear between the two longitudinal positions. In effect the increase in fluid age was taken to be related to the average velocity, or defining the age on streamline, at the  $j^{\text{th}}$  point along the pipe and at the  $m^{\text{th}}$  streamline.

$$T_{m,j} = \frac{2(L_j - L_{j-1})}{(V'_{m,j} + V'_{m,j-1})} + T_{m,j-1} \quad (24)$$





where  $T$  is the age of the fluid, min.

$V'$  is the velocity of the streamline, ft/min.

and  $L$  is the distance from the pipe entrance, ft.

In the process of establishing the use of this definition, several types of age distribution were attempted. It was thought at first that an average age representing each flow increment at a cross-section was sufficient. Therefore, the average age in an increment was calculated from the average velocity across the increment by using the incremental flow rate and the radii of the streamline boundaries. However, the value of shear stress that was obtained proved to be highly dependent on the number of radial increments so that the greater the number, the lower the value of shear stress until it approached a limit. Consequently, in order to obtain an answer which was accurate to 0.01%, based on the finally accepted answer, it would have necessitated the use of about 50 increments, making computational time of the program prohibitive. The percent error in shear stress as a function of the number of increments is shown in Figure 10. As the next step, a linear distribution was assumed across each increment based on the streamline ages as calculated from equation (24). The age of the fluid at the pipe wall was defined to be the amount of time which had elapsed since initiation of flow. Resulting values of shear stress again proved to be highly dependent on the number of radial increments.





However, this time, the values of shear stress rose with an increasing number of increments as in Figure 10. It was found that the width, and therefore the linearization of time distribution, in the increment next to the pipe wall also influenced the solution. A convergent answer independent of this width could not be obtained.

It was then realized that the fluid ages had to be distributed non-linearly across each increment following equation (24). In order to do this, the velocity at the quadrature locations necessary in finding the incremental flow rate were used. This assumed that a quadrature location within an increment was in the same relative position (between two streamlines) at two consecutive cross-sections. For this to be true, the velocity profile in an increment would have to maintain a constant shear rate ratio between the two cross-sections. While in fact, this is not true, for closely spaced longitudinal points, the accompanying error is small, as the minor changes in increment widths at two consecutive cross-sections show (Appendix 4). Figure 10 indicates that the value of shear stress is relatively independent of the number of radial increments when this latter method is used in assigning the age distribution. The errors shown in Figure 10 are based on the result of this scheme using 24 increments.

The iterative procedure which established the shear stress at the wall was now complicated by the necessity of



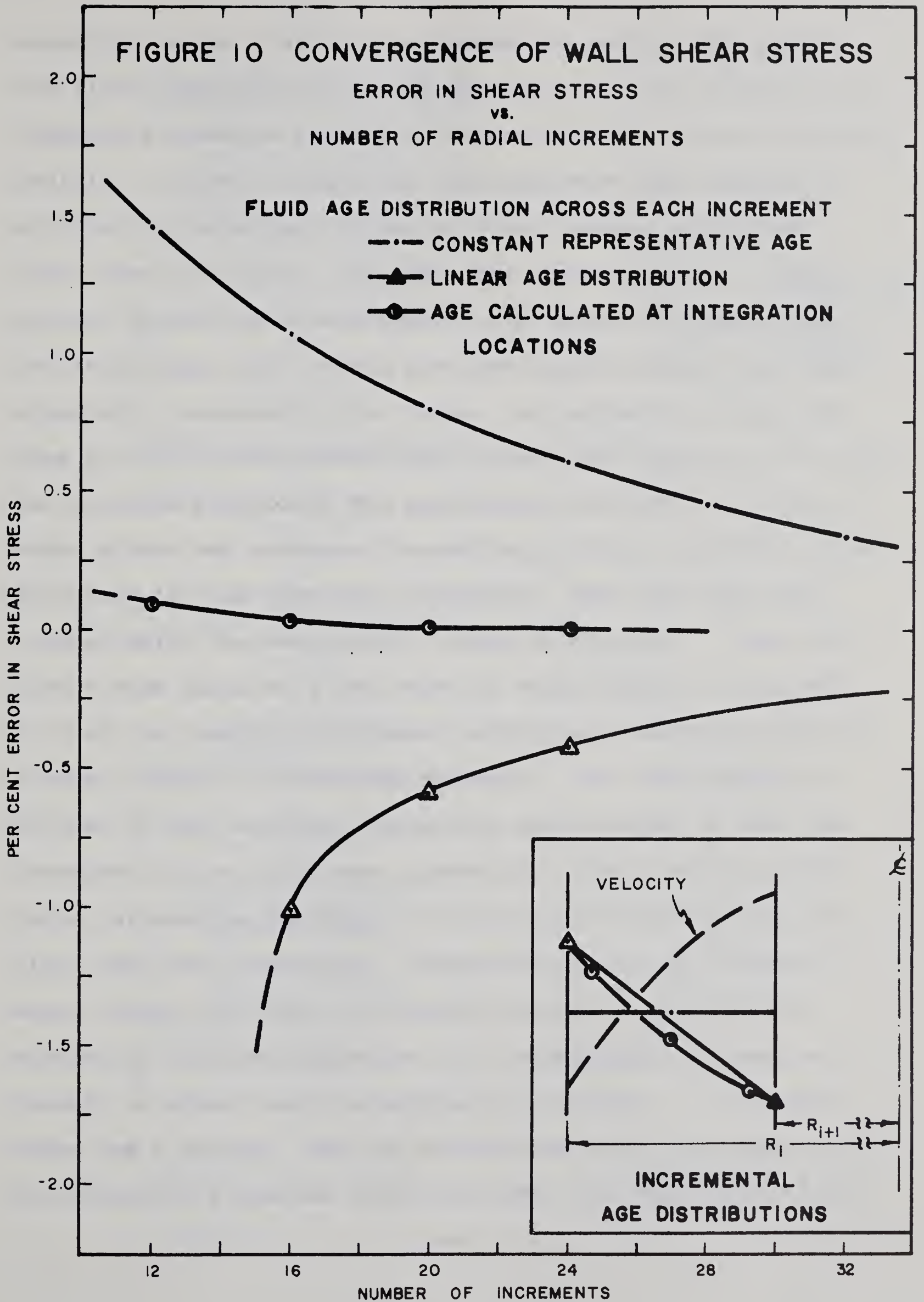




FIGURE 10. CONVERGENCE OF WALL SHEAR STRESS  
 RATIO OF WALL STRESS  
 TO  
 RATIO OF WALL STRESS

WALL STRESS RATIO OF WALL STRESS

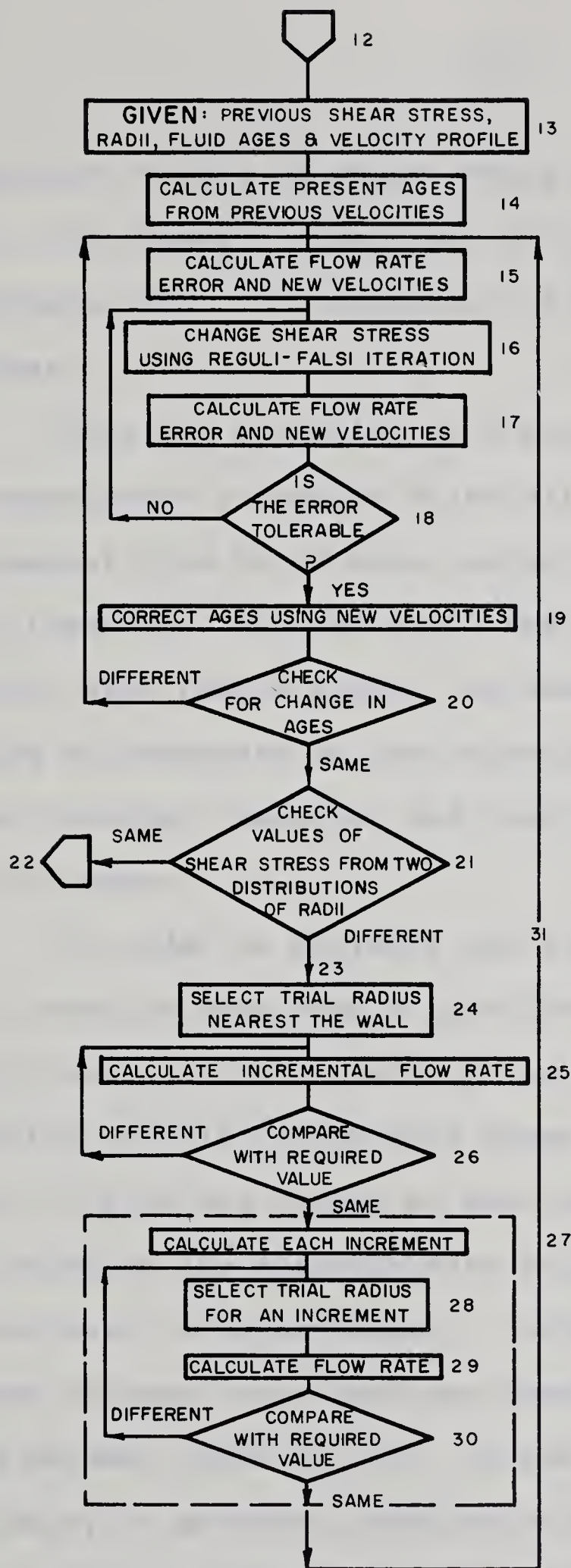
TIME AND DISTANCE RATIO OF WALL STRESS  
 TO  
 RATIO OF WALL STRESS  
 TO  
 RATIO OF WALL STRESS  
 TO  
 RATIO OF WALL STRESS



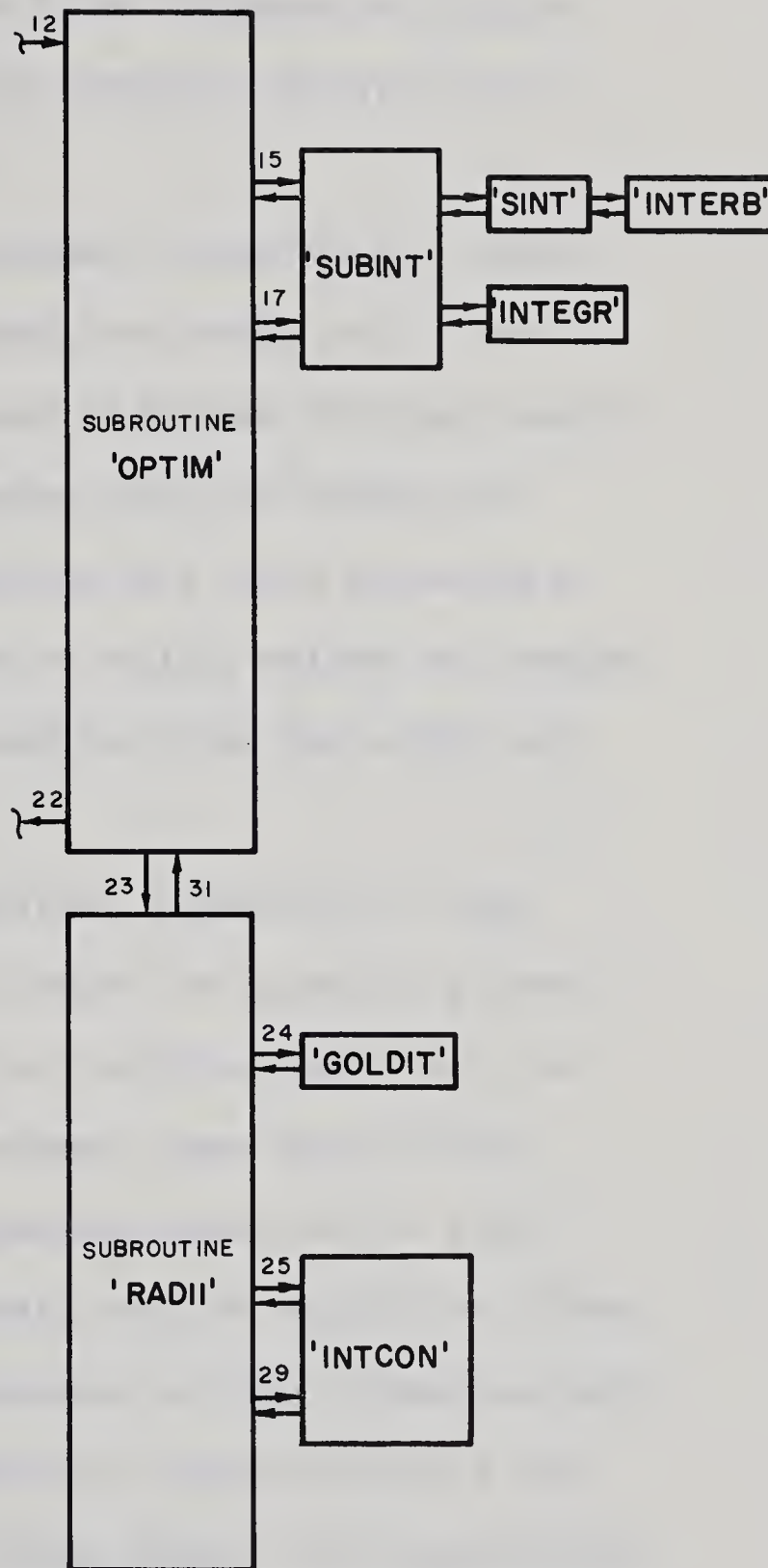


obtaining an age distribution across the radius, and since the fluid properties were time dependent, by the necessity of changing streamline spacing to accommodate the altered velocity profile. Figure 11 shows the technique that was employed in arriving at convergent values of shear stress, velocities, fluid ages, and radii. To begin the computation at a cross-section beyond the pipe entrance, the values of shear stress and streamline radii at the previous cross-section were used along with incremental flow rates. An estimate of the fluid ages for this cross-section were found from equation (24) using the previous profile at the quadrature locations. A value of shear stress was computed through Reguli-falsi iteration until the error in flow rate was acceptable. Then the ages were changed using the newly-found values of velocity. These different ages required a new value of shear stress at the wall, so that the iteration for shear stress was continued until no further change in fluid ages occurred. Then the radial positions of the increment boundaries were altered so that the incremental flow rates were corrected. After changing these radial streamline positions, the values of shear stress and fluid ages were corrected. Comparison of the new value of shear stress with that calculated prior to a shifting of streamline position indicated if a convergence had been attained, in which case the profile was complete. If however, there was a change, then the streamlines were again moved and the iteration procedure continued until the comparison of two





a) SIMPLIFIED FLOW DIAGRAM



b) SUBROUTINE BLOCK DIAGRAM

FIGURE 11

GENERAL CALCULATION OF A FLOW PROFILE





consecutive values of shear stress fell within the convergence limit. The boxes to the right of the flow diagram in Figure 11 indicate the interconnection of the computer program sub-routines.

With the exception of the increment nearest the wall, the convergence procedure which altered the radii until the incremental flow rates were correct was effected through Reguli-falsi iteration. At the wall, the large rate of change of velocity with radius proved too demanding for this procedure causing a divergence in the selection of trial values of radius. Golden interval iteration was then used to find the width of this increment.

In order to estimate the transient behavior in the total pressure drop over a specified length of pipe at a constant flow rate from "start-up" to the limiting condition, a step-wise calculation of wall shear stress down the entire length of pipe was needed at each selected duration of flow. This required the determination of positions at which the interactions were to be performed. Correctness of the linearizations of ages between cross-sections necessarily restricted the distance between these points. On the other hand, the exponential-type decay in pressure gradient increased the allowable separation of these points, for a specified accuracy, from a minimum at the entrance to a very large separation at the end of the pipe. The criterion which established the acceptable distance over which the age distribution could be assumed to be linear





was a comparison of two values of shear stress calculated in the following manner. The shear stress was computed for a cross-section separated from the previous one by a distance  $\Delta L$ . This distance was then cut in half to give two segments  $\Delta L/2$  in length. Computation up to the total length,  $\Delta L$ , proceeded by obtaining the shear stress at  $\Delta L/2$  from the first cross-section and then moving  $\Delta L/2$  to obtain the shear stress at the second. The two values of wall shear stress at  $\Delta L$  from the first profile were then compared. The selection of distances between cross-sections was carried out in subroutine 'LENGTH', the flow diagram for which is shown in Figure 12. After calculation of an initial profile of constant entering age, the shear stress was found at a preselected position. The increment length was halved and the shear stress was found in two steps up to the same previous cross-section. A comparison of shear stresses established whether or not the smaller increment size was sufficiently small or whether it was to be further halved. A minimum increment size, based on the convergence limit established for the program, was found. This step size was used until the comparison of shear stress taken over two increments allowed a doubling in increment size. Thus, a 100 mile pipe was described using 33 positions after starting with a length of 10 feet. Establishment of positions was done for an infinite duration of flow (assumed to be 4000 minutes) since the largest change in pressure gradient



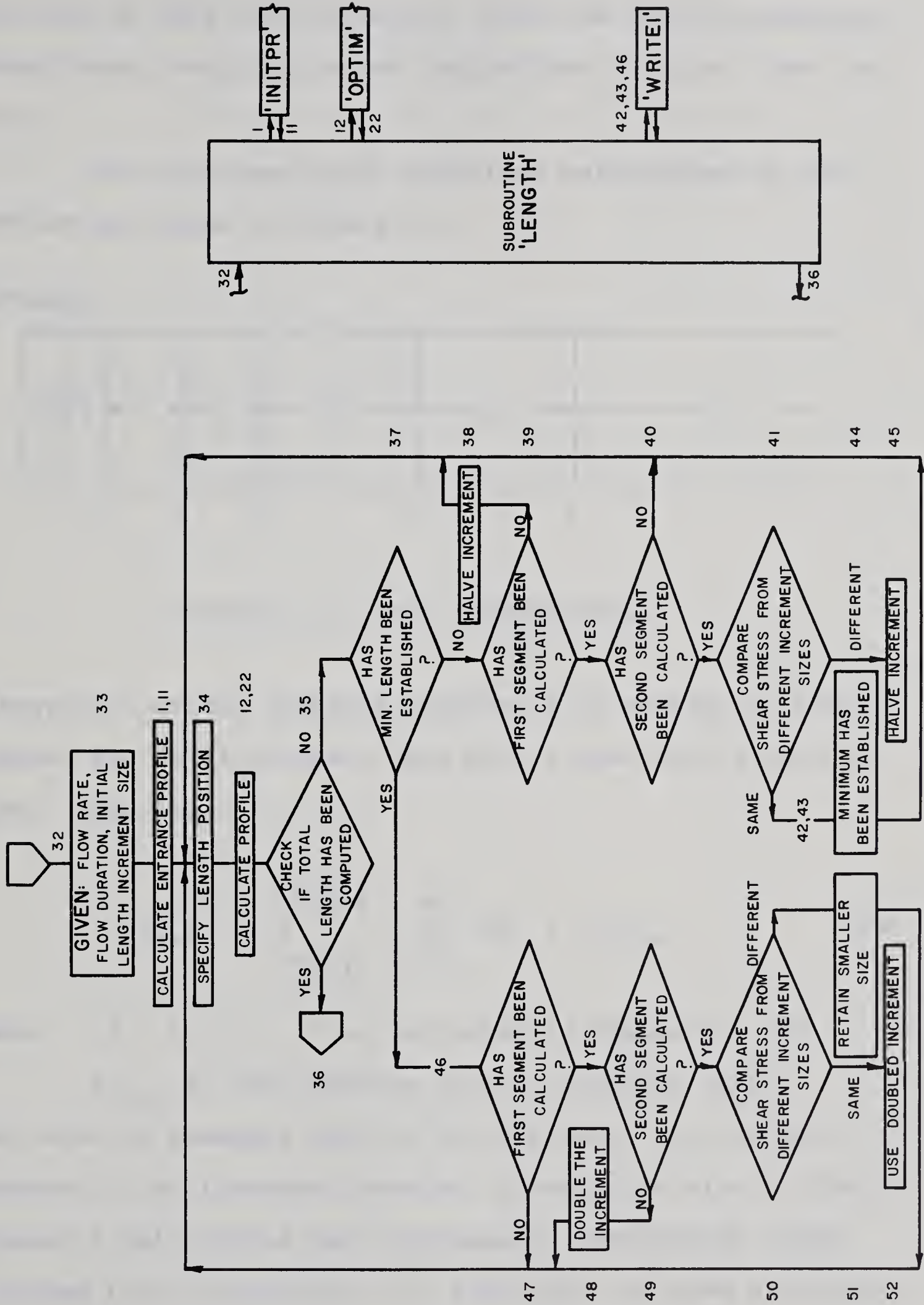


FIGURE 12 SELECTION OF LENGTH INCREMENTS





occurred at this flow duration. With the length positions established, computation was carried out at other flow durations.

The cross-sectional positions established in this problem are shown in Figure 13:

ENTRANCE

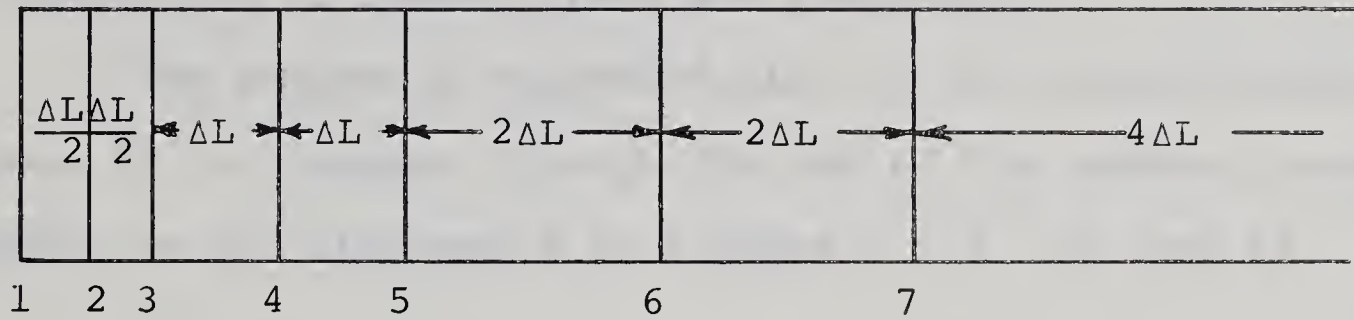


FIGURE 13: PIPE SEGMENTATION

Integration of the pressure gradient with respect to length yielded the total pressure drop over a specified length of line. That is,

$$P_{2j+1} = \int_{L_{2j-1}}^{L_{2j+1}} \frac{dP}{dL} dL + P_{2j-1} \quad (25)$$

where  $(j = 1, 2, \dots)$  as indicated in Figure 13, and

$P_{2j+1}$  is the pressure drop at position  $2j+1$ ;

The value of pressure drop at the entrance,  $P_1$ , was zero.

Because of the increment spacing, integration with a 3-point Simpson's Rule proved very convenient. Subroutine 'TIME' effected this calculation. In addition, the same subroutine

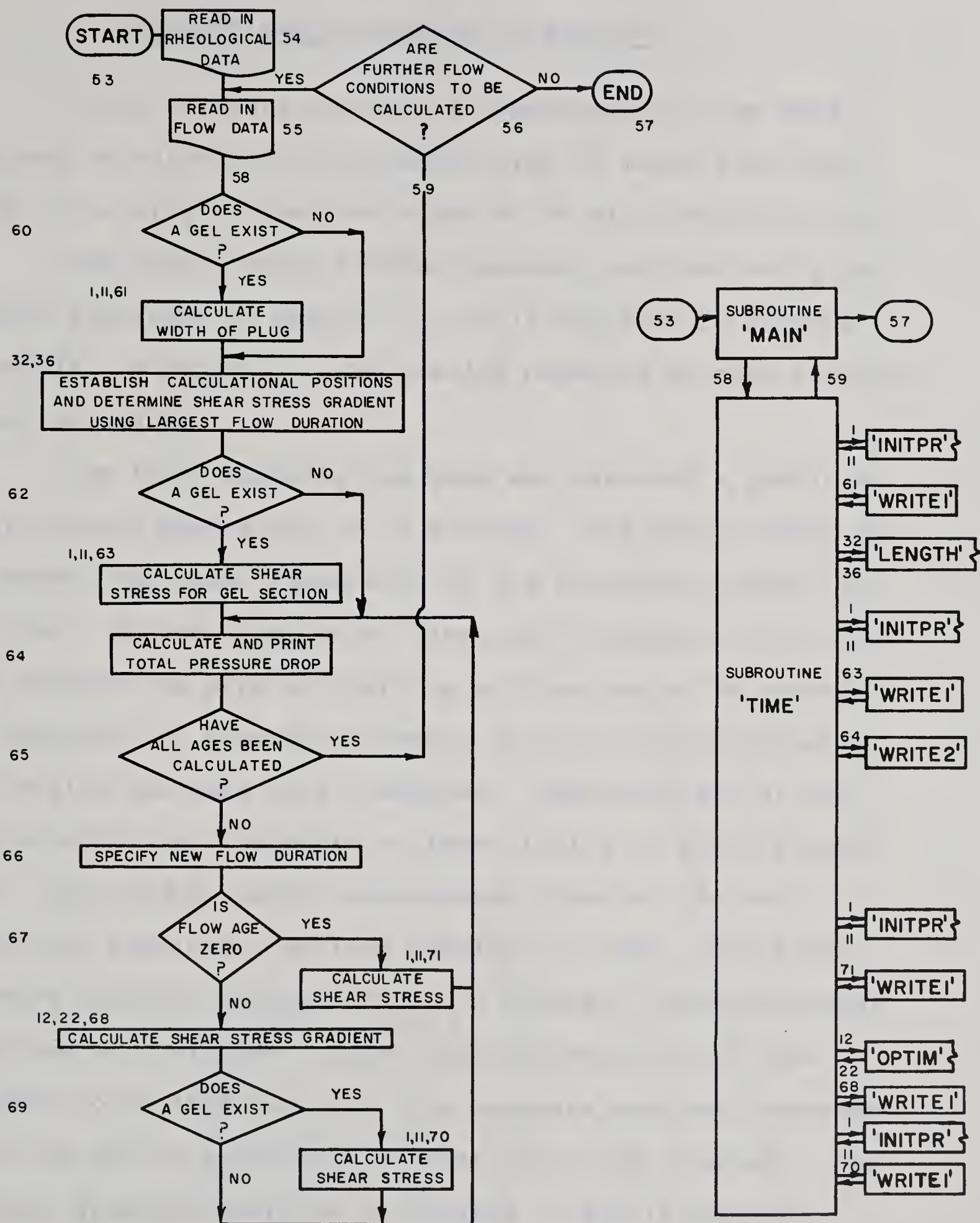


was used to compute the pressure gradient and the accumulated pressure drop at other durations of flow.

A generalized Reynolds number was calculated at each cross-section by way of equation (12) using the apparent viscosity defined by equation (15). While a Reynolds number has not been generalized for fluids with a thixotropic rheology, an indication of laminar flow was necessary.

The schematic representation of the entire program in Figure 14 is pictured through the use of the numbers corresponding to the statements in Figures 9, 11, 12, and 14.





a) SIMPLIFIED FLOW DIAGRAM

b) SUBROUTINE BLOCK DIAGRAM

FIGURE 14 OVERALL COMPUTATIONAL PROCEDURE





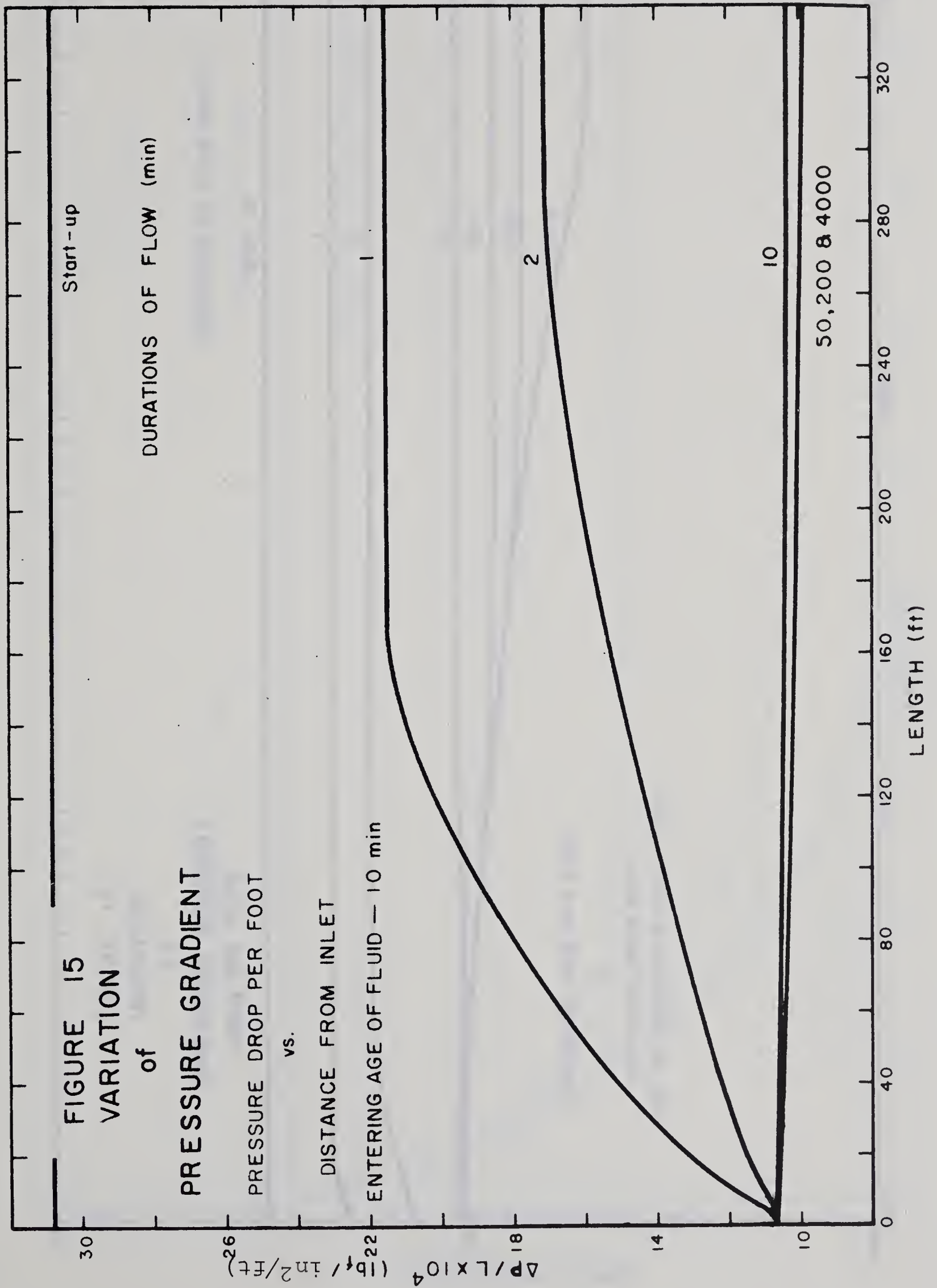
## RESULTS AND DISCUSSION OF RESULTS

Fifty to sixty minutes of computational time were required to calculate the pressure drop at seven flow durations for a single flow rate along a 100 mile length of pipe.

The relationship between pressure gradient and pipe length, tabulated in Appendix 5 and illustrated in Figures 15 and 16, is typical of the results obtained by this computational procedure.

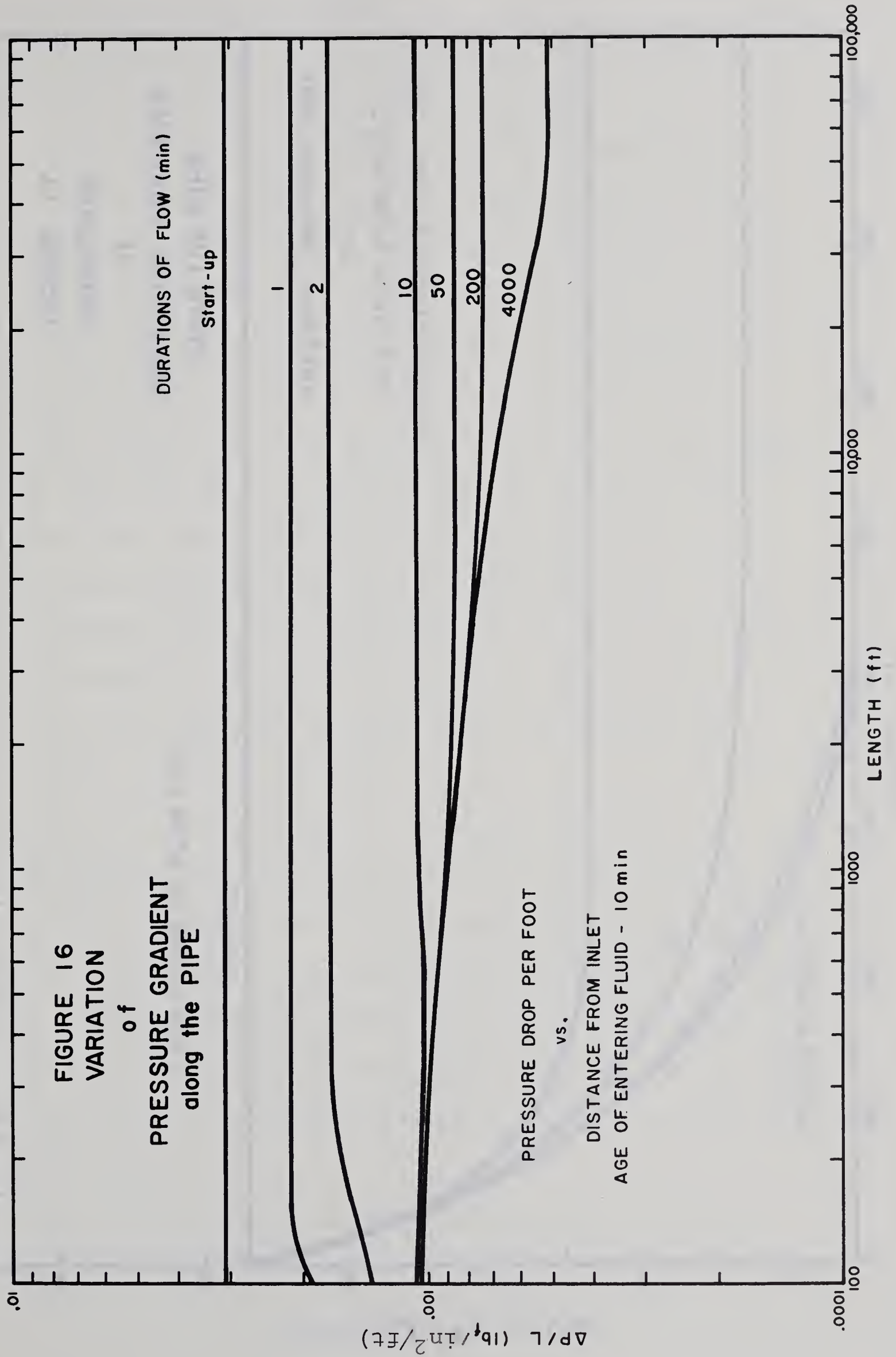
The fluid entering the pipe was assigned a previous shear history equivalent to 10 minutes. Originally there was unsheared (age zero) fluid with no gel structure present in the pipe. At one duration of flow, say 2 minutes, the fluid that entered the pipe at start-up with an age of 10 minutes had undergone 12 minutes of shear, but the fluid originally in the pipe had aged only 2 minutes. Resulting was an age discontinuity and therefore a discontinuity in fluid properties. Age two min. fluid, encountered first at the wall, caused the previously falling gradient to rise. The final pressure gradient corresponded to a constant cross-sectional fluid age of 2 minutes. After infinite duration of flow (assumed to be 4000 minutes), the pressure gradient decreased along the entire pipe until a lower limit was attained. The pressure gradient profiles in Figures 15 and 16 apply to fluid entering with a previous shear history equivalent to 10 minutes. In Figure 17 the entering material has no pre-



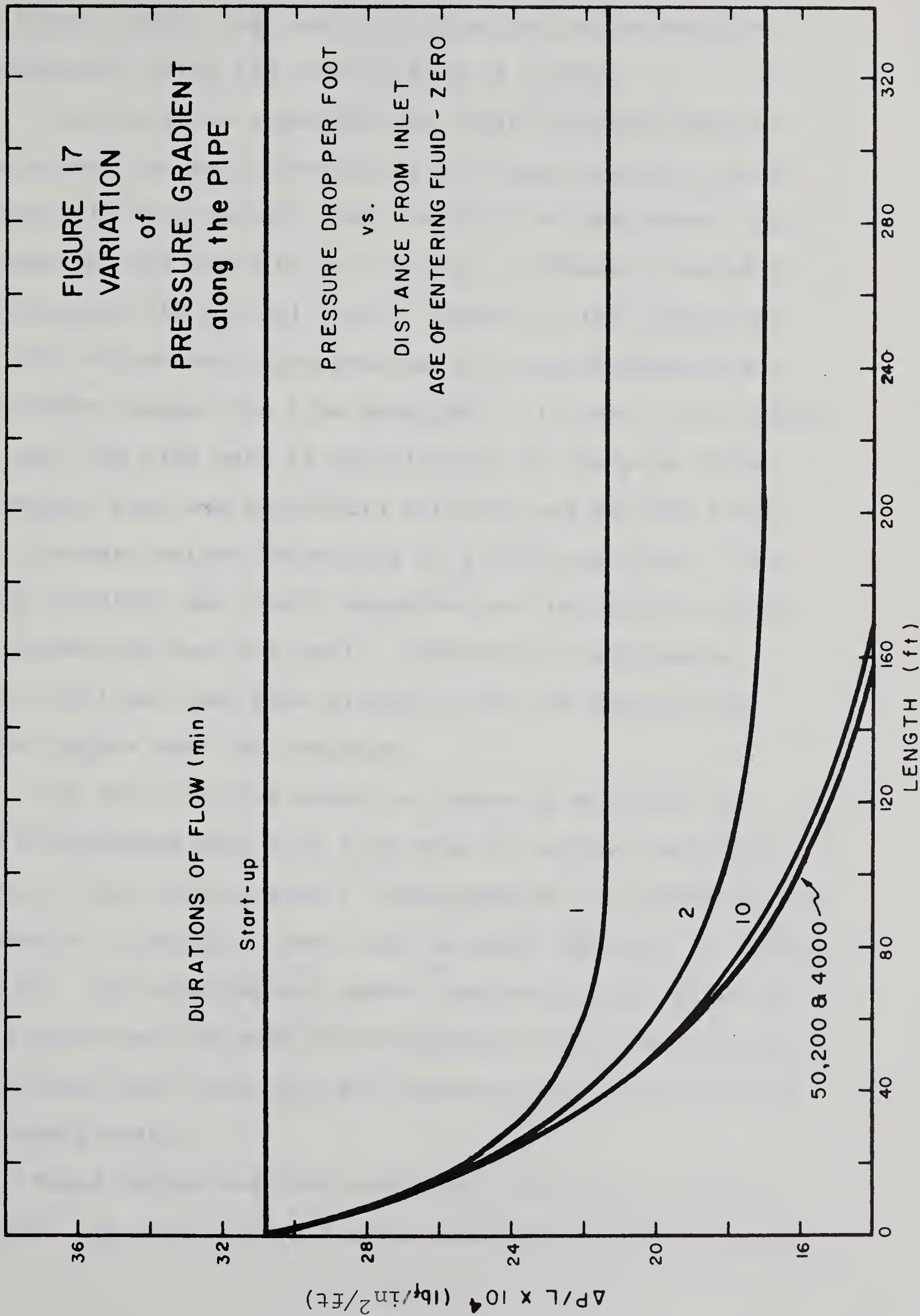














vious shear history (age zero), a situation which would be encountered by using the suction side of a pump.

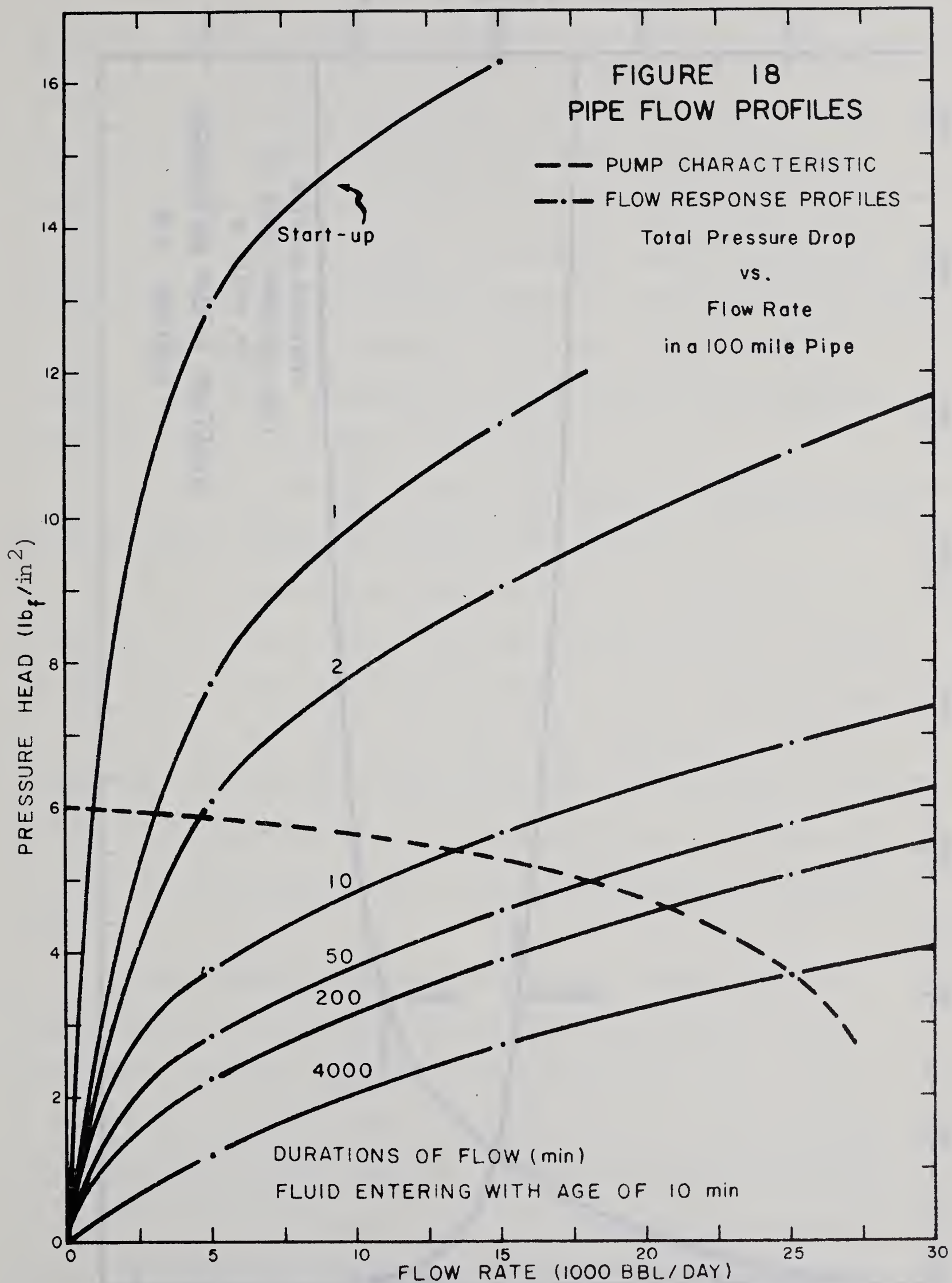
Initially, as expected, the fluid occupying the increments near the wall, because of its lower velocity, aged substantially more rapidly than the fluid at the center line. Consequently, the velocity in the outer increments tended to increase above its initial value. However, with increasing time, this effect was eliminated as the overall ages became more uniform (nearer the flow duration). In fact, at a fixed point near the pipe wall in the vicinity of the pipe inlet, the tendency with age zero fluid entering was for the fluid age to increase before decreasing to a limiting value. The pressure gradient was highly dependent on the fluid's rheological properties near the wall. Therefore, the pressure gradient fell and then rose slightly with the duration of flow for points near the entrance.

The set of curves shown in Figure 18 describe the change in pressure drop with flow rate at various durations of shear. This results from a cross-plot of the pressure drop responses at three flow rates, one of which appeared in Figures 15 and 16. The superimposed curve intersecting the other profiles represented the pump characteristic, defining the unique path through which flow rate and pressure drop can eventually reach steady-state.

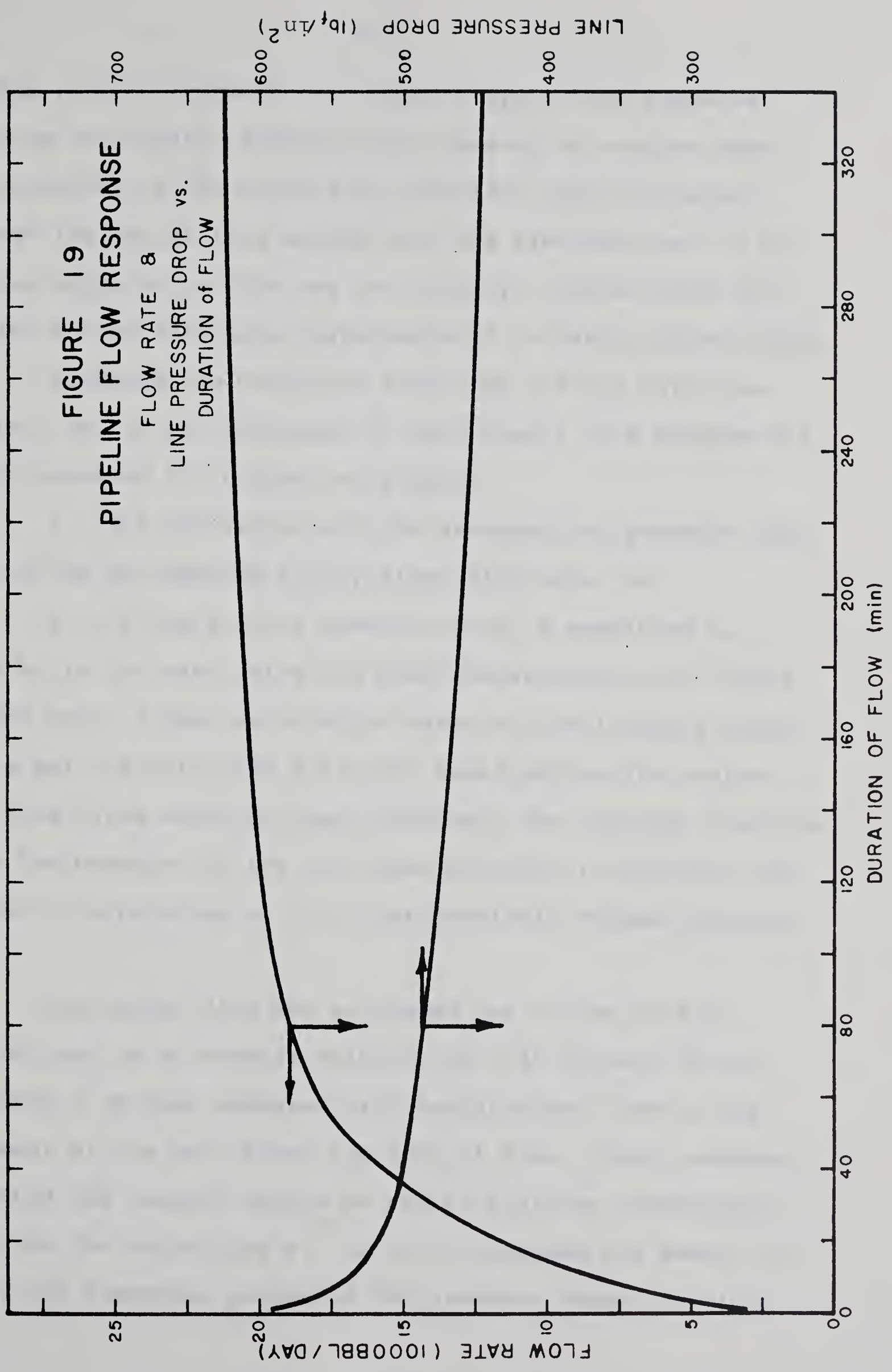
These values are then shown as a function of time in Figure 19. By substituting another pump characteristic curve















for the one in Figure 17, the exact shape of the response could be controlled, enabling the choosing of another pump. For instance, if the originally specified pump indicated through the use of this method that the time required to attain an appreciable flow was too lengthy, another pump displaying a more desirable characteristic is easily substituted.

Although the condition involving a fluid which exhibits a gel is not presented in this thesis, the problem has been programmed to include two aspects:

1. The gel radius and the accompanying pressure drop profile can be computed at any given flow rate, or

2. If the initial pressure drop is specified as would be in the case using the pump characteristic of Figure 18 (600 psi), a hand calculation based on the limiting stress of the gel (in this case 0.47 psf) would define its radius. Then this value would be used throughout the thorough analysis. Since the behavior of the gel after yielding is unknown, any further incorporation of this characteristic becomes speculative.

The radial flow was estimated (at a flow rate of 5000 bbl/day or an average velocity of 0.41 ft/sec) to be less than 0.3% when compared with longitudinal flow in the increment at the wall after ten feet of flow. This increment indicated the largest change in radial position encountered since the low velocities at the wall increased the amount of aging, and therefore presented the greatest change in fluid



consistency when compared with the rest of the pipe cross-section. The assumption that shear stress changes linearly with radius appears reasonable on this basis.

The program proved to be unstable if the convergent limits chosen were not suitable. As an example, if the tolerance of the limit used in establishing distances between the longitudinal cross-sections was not small enough, the pressure gradient showed an oscillation along the pipe. In order to obtain convergent values of the pressure gradient, a short section of pipe was tested. By varying the limits, the effect on various parameters was ascertained and the tolerances were changed to provide the desired accuracy.



## CONCLUSION

The method presented here for predicting the pressure drop for a thixotropic fluid in steady and unsteady state results in the extension of the hand calculational procedure devised by Govier and Ritter(3). No attempt was made to account for the turbulent flow regime, since the transitional region, in which mixing occurs, could not be represented with composite ages or age profiles. Savins and Cox(12), while attempting to describe design procedures for this type of flow, have over-looked the effect of the aging process on the pressure gradient. Their analysis presented the pipeline design criteria for a complex rheological structure which was dependent on temperature only, a facet that was not investigated here.

The reliability of the program that was developed is based on accepting the shear stress decay data as a representation of the rheological properties of a fluid. The assumption is made that shear rate is uniquely related to shear stress at any specified time with the expectation that the structural growth adjustment within the fluid is minor in comparison to the component already represented and also that this growth adjustment is rapid. The inclusion of a pump into the analysis is even more dependent on this tenet.

An experimental program is currently being planned with the aim of establishing 1) the reliability of the program,





2) the accuracy of the transient flow rate and pressure drop responses that were predicted, and 3) the behavior of the gel under shear. The result will indicate whether or not an attempt must be made to include shear stress growth into the model and also will direct further modifications.



NOMENCLATURE

A	Area of pipe, $\text{ft}^2$
$g_c$	Dimensional conversion factor, $\text{lb}_m\text{ft}/\text{lb}_f\text{sec}^2$
K	Fluid consistency index, $\text{lb}_m/\text{ft} (\text{sec})^{2-n}$
K'	Fluid consistency index, $\text{lb}_m/\text{ft} (\text{sec})^{2-n'}$
$k_A$	Network decay rate constant
$k_B$	Network growth rate constant
L	Length, ft
n	Flow behavior index
n'	Flow behavior index
P	Pressure, $\text{lb}_f/\text{ft}^2$
$\Delta P$	Pressure drop, $\text{lb}_f/\text{ft}^2$
Q	Volumetric flow rate, $\text{ft}^3/\text{sec}$
R	Pipe radius, ft
r	Radius, ft
Re	Generalized Reynolds number
t	Time, min.
V	Velocity, ft/sec
$V_A$	Average velocity, ft/sec
$V_R$	Velocity at pipe wall, ft/sec
$V_r$	Velocity at radius r, ft/sec
v	Velocity in direction of flow, ft/sec
y	Distance between shear planes, ft
$dv/dy$	Shear rate, $\text{sec}^{-1}$
$dv/dr$	Shear rate, $\text{sec}^{-1}$





### Greek Symbols

$\mu$	Viscosity, $\text{lb}_m/\text{ft}.\text{sec}$
$\mu'$	Coefficient of rigidity, $\text{lb}_m/\text{ft}.\text{sec}$
$\mu_A$	Apparent viscosity evaluated at wall shear stress $\text{lb}_m/\text{ft}.\text{sec}$
$\rho$	Fluid density, $\text{lb}_m/\text{ft}^3$
$\tau$	Shear stress, $\text{lb}_f/\text{ft}^2$
$\tau_s$	Structural component of shear stress, $\text{lb}_f/\text{ft}^2$
$\tau_w$	Shear stress at the wall, $\text{lb}_f/\text{ft}^2$
$\tau_y$	Yield stress of a Bingham Plastic, $\text{lb}_f/\text{ft}^2$
$\tau_\mu$	Newtonian Component of shear stress, $\text{lb}_f/\text{ft}^2$

### Subscripts

i	Refers to streamline
j	Refers to pipe cross-section
m	Refers to streamline
o	Refers to initial condition
l	Parameter evaluated after 1 minute
$\infty$	Refers to equilibrium value



BIBLIOGRAPHY

1. Bird, R.B., Stewart, W.E. and Lightfoot, E.N., "Transport Phenomena", Wiley, New York (1962).
2. Auld, R.G. and Ritter, R.A., "Flow of Fluids in Pipes and Annuli", presented at the 49th Annual C.I.C. Meeting, Saskatoon, Saskatchewan.
3. Govier, G.W. and Ritter, R.A., "Pipeline Flow Characteristics of Crude Oils", Division paper of the E.I.C. (1963).
4. Davenport, T.C. and Russel, R.J., J. Inst. Pet., 46, 143 (1960).
5. Wyllie, D. and Jones, J.T., J. Inst. Pet., 46, 161 (1960).
6. Ritter, R.A. and Govier, G.W., "The Development and Evaluation of a Theory of Thixotropic Behavior".
7. Ritter, R.A., Ph.D. Thesis, University of Alberta (1961).
8. Cheng, D.C.-H. and Evans, F., Brit. J. Appl. Phys., 16, 1599 (1965).
9. Hahn, S.J., Ree, T. and Eyring, H., I. & E.C., 51, 857 (1959).
10. Denny, D.A. and Brodkey, R.S., J. Appl. Phys., 33, 2269 (1962).
11. Cheng, D.C.-H., Ray, D.J. and Valentin, F.H.H., Trans. Inst. Chem. Engrs., 43, T176 (1965).
12. Savins, J.G. and Cox, D.B., Fuel J., 42, 363 (1963).
13. Schlichting, H., "Boundary Layer Theory", McGraw-Hill (1960).
14. Savins, J.G., Wallick, G.C. and Foster, W.R., Soc. of Pet. Engrs., J., Sept., 211 (1962).
- 15a. \*Rabinowitsch, B., Z. Physik. Chem., 1, 145A (1929).
- 15b. \*Mooney, M., J. Rheol., 2, 210 (1931).
16. Metzner, A.B. and Reed, J.C., A.I.Ch.E. Journal, 1, 434 (1955).



17. Brodkey, R.S., I. & E.C., 54, No. 9, 45 (1962).
  18. Shaver, R.G. and Merrill, E.W., A.I.Ch.E. Journal, 5, 181 (1959).
  19. Discussion At the Symposium on Flow Properties of Admiralty Fuel Oils, J. Inst. Pet., 46, 177 (1960).
  20. Lapidus, L., "Digital Computation for Chemical Engineers", Mc-Graw-Hill, New York (1962).
  21. Kopal, Z., "Numerical Analysis", Chapman and Hall, London (1955).
  22. Wilde, D.J., "Optimum Seeking Methods", Prentice-Hall, Englewood Cliffs, N.J. (1964).
- \* These papers were not read but appear as references in (14) and (16).

#### SUPPLEMENTARY REFERENCES

- Eirich, F.R., "Rheology", 3 Vols, Academic Press, New York, (1959, 1958, 1960)
- Fredrickson, A.G., "Principles and Applications of Rheology", Prentice-Hall, Englewood Cliffs, N.J. (1964).
- Freundlich, H., "Thixotropy", Herman, Paris (1935).
- Merril, E.W., "Non-Newtonianism in Thin Liquid", in "Modern Chemical Engineering", Vol. 1, Ed. by A. Acrivos, Reinhold, London (1963).
- Metzner, A.B., "Non-Newtonian Technology", in "Advances in Chemical Engineering", Vol. 1, Ed. by T. B. Brew and J. W. Hoopes, Jr., Academic Press, New York (1956).
- Reiner, M., "Deformation and Flow", Lewis, London (1949).
- Wazer, J.R. van, Lyons, J.W., Kim, K.Y. and Colwell, R.E., "Viscosity and Flow Measurement", Interscience, New York, (1963).
- Wilkinson, W.L., "Non-Newtonian Fluids", Pergamon Press, London (1960).





## A P P E N D I X 1

### NUMERICAL TECHNIQUES



1. Lagrangian Interpolation Polynomial(20)

A polynomial of degree  $n$  is known to be uniquely specified by  $n+1$  constants or  $n+1$  points. With  $(n+1)$  points in which  $x_1 - x_0 \neq x_2 - x_1 \neq \dots \neq x_n - x_{n-1}$  an interpolation polynomial of degree  $n$  is written in the form.

$$\begin{aligned}\phi_n(x) &= a_0(x-x_1)(x-x_2)\dots(x-x_n) \\ &\quad + a_1(x-x_0)(x-x_2)\dots(x-x_n) \\ &\quad + \dots \\ &\quad + a_n(x-x_0)(x-x_1)\dots(x-x_{n-1}) \quad (1-1)\end{aligned}$$

with coefficients  $a_0, a_1, \dots, a_n$ .

Setting  $x = x_0$ , then  $y_0 = \phi(x_0)$ . For a given set of data,

$$y_0 = a_0(x_0 - x_1)(x_0 - x_2)\dots(x_0 - x_n)$$

yielding the constant  $a_0$ ,

$$a_0 = \frac{y_0}{(x_0 - x_1)(x_0 - x_2)\dots(x_0 - x_n)}$$

The remaining coefficients are found in a similar manner to produce the interpolation polynomial

$$\phi_n(x) = \frac{(x - x_1)(x - x_2)\dots(x - x_n)}{(x_0 - x_1)(x_0 - x_2)\dots(x_0 - x_n)} y_0$$





$$\begin{aligned}
& + \frac{(x - x_0)(x - x_2) \dots (x - x_n)}{(x_1 - x_0)(x_1 - x_2) \dots (x_1 - x_n)} y_1 \\
& + \dots \\
& + \frac{(x - x_1)(x - x_2) \dots (x - x_{n-1})}{(x_n - x_0)(x_n - x_1) \dots (x_n - x_{n-1})} y_n \quad (1-2)
\end{aligned}$$

Setting

$$\beta_n(x) = (x - x_0)(x - x_1) \dots (x - x_{n-1})(x - x_n)$$

then

$$\frac{d\beta_n(x_j)}{dx} \text{ becomes } (x_j - x_0)(x_j - x_1) \dots (x_j - x_{j-1})$$

$$(x_j - x_{j+1}) \dots (x_j - x_n)$$

and

$$\phi_n(x) = \sum_{j=0}^n \frac{\beta_n(x)}{(x - x_j) \beta'_n(x_j)} y_j \quad (1-3)$$

represents the Lagrangian interpolation polynomial.

## 2. Gaussian Quadrature(21)

Gaussian quadrature is one of the more accurate integration techniques. An abbreviated development of it follows.

If the degree of curvature of a line to be represented by  $n+1$  points is greater than  $n$ , say by  $r$ , then there exist  $(r+1)$  values on the interval between  $x_0$  and  $x_n$  at which the



$n^{\text{th}}$  derivative of  $y(x)$  vanishes; the complete term is non-vanishing. The Lagrangian polynomial, along with the remainder term, obtained from a determination of coefficients is

$$y(x) = \sum_{j=0}^n \frac{\beta_n(x)}{(x - x_j) \beta'_n(x_j)} + \frac{\beta_n(x)}{(n)!} y^{(n)}(x) \quad (1-4)$$

Integration of the polynomial from  $a$  to  $b$

$$\begin{aligned} \int_a^b y(x) dx &= \sum_{j=0}^n \left( \int_a^b \frac{\beta_n(x)}{(x - x_j) \beta'_n(x_j)} dx \right) y(x_j) \\ &+ \int_a^b \frac{\beta_n(x)}{n!} y^{(n)}(x) dx \end{aligned}$$

and setting the "weighting" function

$$H_j = \int_a^b \frac{\beta_n(x)}{(x - x_j) \beta'_n(x_j)} dx$$

then

$$\int_a^b y(x) dx = \sum_{j=0}^n H_j y(x_j) + \int_a^b \frac{\beta_n(x)}{n!} y^{(n)}(x) dx$$

By representing  $y^{(n)}(x)$  by an orthogonal Legendre Polynomial of degree  $n$ , the Product  $\beta_n(x) y^{(n)}(x)$  represents a polynomial of degree  $2n+1$ . Since the product is zero at the roots of the orthogonal polynomial  $H_j$ 's can be evaluated at those points, and the integral "exactly" represents a polynomial of degree  $2n+1$  with  $n+1$  points, i.e.



$$\int_a^b f(x) dx = \sum_{j=0}^n H_j y(x_j) \quad (1-5)$$

### 3. Golden Interval Iteration(22)

A searchplan which is independent of the shape of a function and yet minimizes the maximum interval of uncertainty is known as minimax. Golden interval iteration is such a technique.

Consider an experiment, placed on the interval that remains after  $j-1$  experiments, such as in Figure (1-1).

$$\text{Then } L_{j-1} = L_j + L_{j+1} \quad (1-6)$$

where  $L$  represents the interval length, and  $j$  is the experiment number

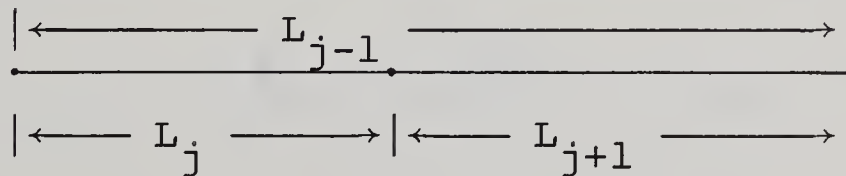


FIGURE 1-1

The points are so spaced that

$$\frac{L_{j-1}}{L_j} = \frac{L_j}{L_{j+1}} \equiv \tau \quad (1-7)$$

Then from (1-7)

$$\frac{L_{j-1}}{L_{j+1}} = \tau^2$$





Substitution into (1-6) yields

$$\tau = \frac{1 + \sqrt{5}}{2}.$$

Consider now two experiments simultaneously placed in Figure

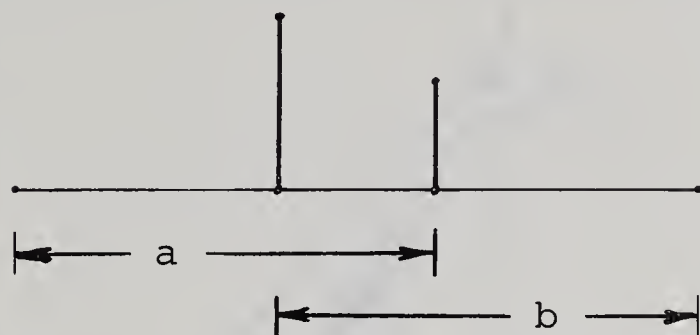


FIGURE 1-2

The interval in which the minimum (maximum) lies is  $b(a)$  or if this represents the  $j-1^{\text{st}}$  experiment, then

$$L_j = \frac{L_{j-1}}{\tau}$$

After  $n$  experiments, it can be shown that

$$L_n = \frac{L_I}{\tau^{n-1}} \quad (1-8)$$

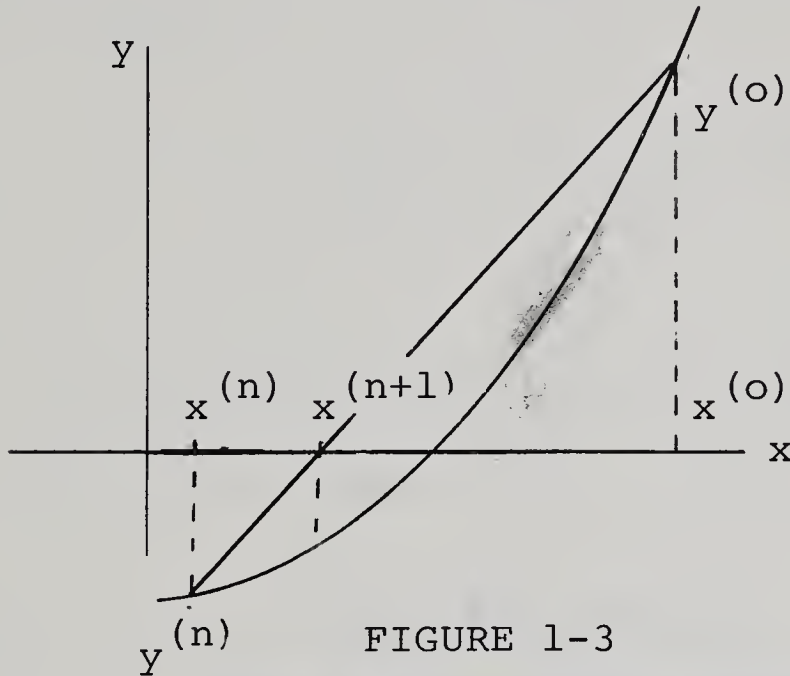
where  $L_I$  is the initial interval length.

$1/\tau^{n-1}$  represents the reduction of the interval length after  $n$  experiments regardless of the dependent variable's functionality.



4. Reguli-falsi(20)

Reguli-falsi is a simple method for finding the root of a function through iteration. If the function is pictured by Figure (1-3), then the  $n+1^{\text{st}}$  trial of  $x$



is given by

$$x^{(n+1)} = \frac{x^{(n)} - y^{(n)} (x^{(n)} - x^{(0)})}{(y^{(n)} - y^{(0)})} \quad (1-9)$$

where subscript 0 represents the base point.

Although it was not necessary for the program presented by this thesis, in the process of its development a curve on which there was an inflection at the x-axis was encountered. By moving the base point when  $y^{(n)}$  became positive, it was possible to obtain a solution in about one half to one third of the number of trials required by Golden Interval.





## A P P E N D I X 2

### USE OF LAGRANGIAN INTERPOLATION



The equation of state was represented mathematically by

$$\left(-\frac{dv}{dr}\right) = \phi(\tau, t) \quad (2-1)$$

Discrete values of data represented the surface so that (2-1) becomes

$$\left(-\frac{dv}{dr}\right)_{i,j} = \phi(\tau_i, t_{i,j})$$

In order to obtain the required value  $(-dv/dr)^*$  for  $\tau^*$  and  $t^*$  the interpolation first affixed a position to shear stress and time as in Figure (2-1). Then, use of the

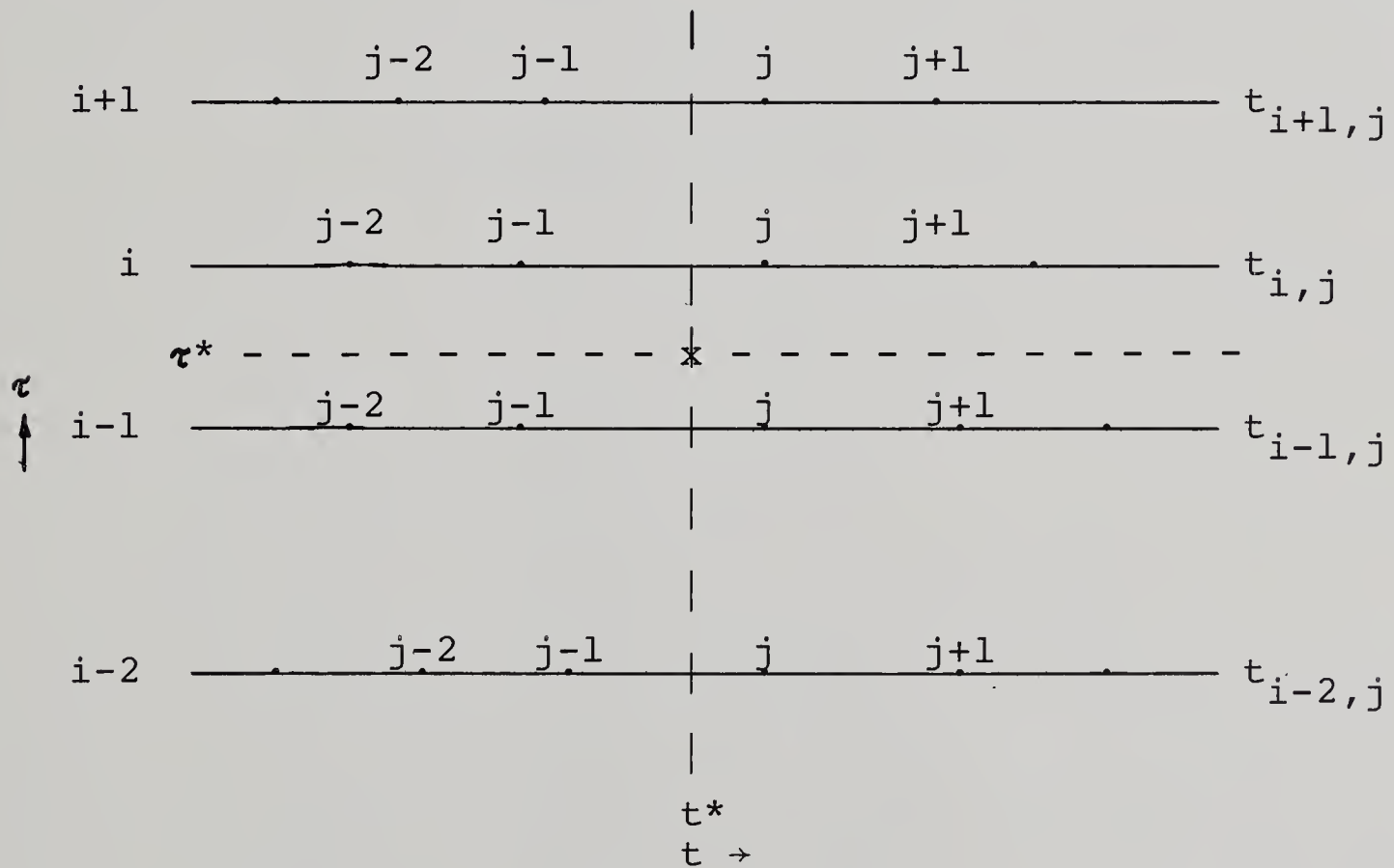


FIGURE 2-1



interpolation yielded values of shear rate making shear rate a function of shear stress.

$$\left(\frac{dv}{dr}\right)_{i,j} = \phi_j(\tau_i)$$

The final interpolation along the  $t^*$  line produced  $(-dv/dr)^*$ . This interpolation has been programmed in Fortran IV in subroutine 'INTERB' in Appendix 3 .





## A P P E N D I X 3

### COMPUTER PROGRAMS



```

C   THIS PROGRAM CALCULATES THE PRESSURE DROP ALONG A PIPE FOR
C   A THIXOTROPIC FLUID.
C   THE PROGRAM IS WRITTEN IN FORTRAN IV.
C   THIS IS THE CONTROL SUBROUTINE, READING IN ALL
C   NECESSARY DATA.
C   ALL 'READ' FORMAT STATEMENTS APPEAR AS A BLOCK AT THE
C   BEGINNING OF THE DATA.
C
C   LIST OF SYMBOLS
C   JWRITE - FLAG INTEGER. IF GREATER THAN ZERO, FLUID
C           DATA IS PRINTED.
C   JW1    - FLAG INTEGER. IF GREATER THAN ZERO, EACH
C           FLOW PROFILE IS PRINTED VIA 'WRIT1'.
C   JW2    - FLAG INTEGER. IF GREATER THAN ZERO, THE
C           ACCUMULATED PRESSURE DROP AT EACH DURATION OF
C           FLOW IS PRINTED VIA 'WRITE2'.
C   JS     - NUMBER OF DATA VALUES OF SHEAR STRESS.
C   GTOW( ) - SHEAR STRESS VALUES IN DATA (LB/SQ FT X 1000).
C   JT( )   - NUMBER OF DATA VALUES OF TIME AND SHEAR
C           RATE AT EACH SHEAR STRESS (I.E. UP TO JS).
C   GT( , ) - FLUID AGE MATRIX, I.E. A VECTOR OF AGES AT
C           EACH SHEAR STRESS (MIN).
C   GDVDR( , ) - SHEAR RATE MATRIX, I.E. A VECTOR OF
C           SHEAR RATE CORRESPONDING TO EACH SHEAR STRESS
C           (1/SEC).
C   QP     - FLOW RATE.
C   JV     - FLAG INTEGER DESCRIBING FLOW RATE UNITS.
C           IF JV IS GREATER THAN 0, BBL/DAY
C           IF JV IS LESS THAN OR EQUAL TO 0, CU FT/SEC.
C   RHO    - FLUID DENSITY (LB/CU FT).
C   XL     - PIPE LENGTH(FT).
C   RF     - PIPE RADIUS (FT).
C   DELTAL - LENGTH INCREMENT TRIAL SIZE (FT).
C   REC    - CONSTANT FOR OBTAINING REYNOLDS NO. (SQ FT/LB).
C   VA     - AVERAGE VELOCITY (FT/SEC).
C   TINIT  - AGE OF ENTERING FLUID (MIN).
C   TOWMIN - LIMITING STRESS - IF ONE EXISTS (LB/SQ FT).
C   RA     - IS THE GEL RADIUS.
C   N      - TRIAL NUMBER OF RADIAL INCREMENTS.
C   NMAX   - MAXIMUM VALUE OF N NECESSARY.
C   EPS1   - CONVERGENCE LIMIT IN 'INITPR' ON FLOW ERROR.
C   EPS2   - CONVERGENCE LIMIT IN 'INITPR' FOR ESTABLISHING
C           NUMBER OF RADIAL INCREMENTS.
C   EPS3   - CONVERGENCE LIMIT IN 'RADII' FOR CHANGING
C           STREAMLINE POSITIONS.
C   EPS4   - CONVERGENCE LIMIT IN 'OPTIM' ON FLUID AGES.
C   EPS5   - INITIAL CONVERGENCE LIMIT IN 'OPTIM' FOR
C           WALL SHEAR STRESS.
C   EPS6   - FINAL CONVERGENCE LIMIT IN 'OPTIM' FOR WALL
C           SHEAR STRESS.
C   EPS7   - CONVERGENCE LIMIT IN 'LENGTH' FOR
C           ESTABLISHING LONGITUDINAL POSITIONS.

```



ESTABLISHING LONGITUDINAL POSITIONS.  
CONVERGENCE LIMIT IN LENGTH, FOR  
EP27

FINAL CONVERGENCE LIMIT IN OPTIM, FOR WALL  
SHEAR STRESS.  
EP26

INITIAL CONVERGENCE LIMIT IN OPTIM, FOR  
CONVERGENCE LIMIT IN OPTIM, ON FLUID AGES.  
EP25

STREAMLINE POSITIONS.  
CONVERGENCE LIMIT IN RADII, FOR CHANGING  
NUMBER OF RADIAL INCREMENTS.  
EP23

CONVERGENCE LIMIT IN INITPR, ON FLOW ERROR.  
CONVERGENCE LIMIT IN INITPR, FOR ESTABLISHING  
MAXIMUM VALUE OF N NECESSARY.  
N  
- TRIAL NUMBER OF RADIAL INCREMENTS.  
- IS THE GEL RADIUS.  
- LIMITING STRESS - IF ONE EXISTS (LBS/20 FT).  
TOWMIN

AGE OF ENTERING FLUID (MIN).  
TINIT  
- AVERAGE VELOCITY (FT/SEC).  
- CONSTANT FOR OBTAINING REYNOLDS NO. (20 FT/10).  
CELTA  
- LENGTH INCREMENT TRIAL SIZE (FT).  
- PIPE RADIUS (FT).  
RF  
- PIPE LENGTH(FT).  
XL  
- FLUID DENSITY (LBS/CU FT).  
RHO  
IF JV IS LESS THAN OR EQUAL TO 0, CU FT/SEC.  
IF JV IS GREATER THAN 0, BBL/DAY  
JV  
- FLAG INTEGER DESCRIBING FLOW RATE UNITS.  
- FLOW RATE.  
QP  
(1/SEC).

SHEAR RATE CORRESPONDING TO EACH SHEAR STRESS  
GDVDR1, ) - SHEAR RATE MATRIX, I.E. A VECTOR OF  
EACH SHEAR STRESS (MIN).  
GT1, ) - FLUID AGE MATRIX, I.E. A VECTOR OF AGES AT  
RATE AT EACH SHEAR STRESS (I.E. UP TO 32).  
- NUMBER OF DATA VALUES OF TIME AND SHEAR  
- SHEAR STRESS VALUES IN DATA (LBS/20 FT X 1000).  
GTOW1 )  
- NUMBER OF DATA VALUES OF SHEAR STRESS.  
J2  
FLOW IS PRINTED VIA 'WRITES'.

ACCUMULATED PRESSURE DROP AT EACH DURATION OF  
- FLAG INTEGER, IF GREATER THAN ZERO, THE  
FLOW PROFILE IS PRINTED VIA 'WRIT1'.  
- FLAG INTEGER, IF GREATER THAN ZERO, EACH  
DATA IS PRINTED.  
JW1  
- FLAG INTEGER, IF GREATER THAN ZERO, FLUID  
JWRITE

### LIST OF SYMBOLS

BEGINNING OF THE DATA.  
ALL 'READ' FORMAT STATEMENTS APPEAR AS A BLOCK AT THE  
NECESSARY DATA.  
THIS IS THE CONTROL SUBROUTINE, READING IN ALL  
THE PROGRAM IS WRITTEN IN FORTRAN IV.  
A THIXOTROPIC FLUID.  
THIS PROGRAM CALCULATES THE PRESSURE DROP ALONG A PIPE FOR



```

C      TT( )      - VECTOR OF FLOW DURATIONS TO BE CALCULATED.
C      NT        - NUMBER OF FLOW DURATIONS.
C      NNN        - FLAG INTEGER. IF GREATER THAN ZERO, A NEW SET
C                  OF CONDITIONS ON THE SAME FLUID IS READ.
      REAL F1(12), F2(12), F3(12), F4(12), F5(12), F6(12),
1 F7(12), F8(12), F9(12), F10(12)
      REAL GTOW(30), GT(30,30), GDVDR(30,30), QP, QG, RF, DELTAL,
1 TINIT, TOWMIN, EPS1, EPS2, EPS3, EPS4, EPS5, EPS6, EPS,
2 TT(10), REC, XL, RR, RHO, VA
      INTEGER I, J, JS, JT(30), JXA, JWRITE, JV, N, NMAX, JW1,
1 JW2, NT, NNN
100  FORMAT(12A6)
101  FORMAT(1HK,14X,25HTHE AVG. VELOCITY IS THEN,F7.4,
1 8H FT/SEC.)
102  FORMAT(1HK,14X,26HTHE RADIUS OF THE PIPE IS ,F5.2,4H FT.)
103  FORMAT(1HK,14X,27HTHE DENSITY OF THE FLUID IS,F7.3,
1 10H LB/CU FT.)
104  FORMAT(1HK,14X,28HITS LIMITING SHEAR STRESS IS,F6.3,
1 10H LB/SQ FT.)
105  FORMAT(1HK,13X,12,2X,25HFLOW AGES ARE CALCULATED.)
106  FORMAT(1H1,14X,9HTHERE ARE,13,24H VALUES OF SHEAR STRESS.)
107  FORMAT(1HK,14X,8HFOR TOW(,13,4H ) =,F10.4,11H ,THERE ARE,
1 13,13H DATA POINTS.)
108  FORMAT(1HJ,14X,3(20H TIME - SHEAR RATE))
109  FORMAT(1H3,14X,17HTHE FLOW RATE IS ,F11.3,2X,11HBBL/DAY OR,)
110  FORMAT(1HK,14X,17HTHE FLOW RATE IS ,F11.8,3X,
1 19HCUBIC FEET PER SEC.)
111  FORMAT(1H ,14X,6F10.4)
112  FORMAT(1HK,14X,18HTHE PLUG RADIUS IS,F8.5,4H FT.)
      READ(5,100) F1, F2, F3, F4, F5, F6, F7, F8, F9, F10
      READ(5,F1) JS, JWRITE, JW1, JW2
      READ(5,F2) (GTOW(J), J=1,JS)
      READ(5,F3) (JT(J), J=1,JS)
      DO 900 J=1,JS
      JXA=JT(J)
900  READ(5,F4) (GT(I,J), GDVDR(I,J), I=1,JXA)
      IF (JWRITE.LT.1) GO TO 901
      WRITE(6,106) JS
      DO 902 J=1,JS
      JXA=JT(J)
      WRITE(6,107) J, GTOW(J), JXA
      WRITE(6,108)
902  WRITE(6,111) (GT(I,J), GDVDR(I,J), I=1,JXA)
901  READ(5,F5) QP, JV, RHO, XL
      WRITE(6,109) QP
      QG=QP
      IF (JV.GT.0) QG=QP*0.64983333E-04
      IF (JV.GT.0) WRITE (6,110) QG
      READ(5,F6) RF, DELTAL, TINIT, TOWMIN, N, NMAX, RA
      READ(5,F7) EPS1, EPS2, EPS3, EPS4, EPS5, EPS6, EPS7
      VA=QG/(3.1415927*RF**2)
      READ(5,F8) NT

```



```

READ(2,F8) NT
VA=CV(3.1415925*RF**2)
READ(2,F7) EP21, EP22, EP23, EP24, EP25, EP26, RA
IF (JV.GT.0) WRITE (6,110) QG
IF (JV.GT.0) DC=DP*0.6438333E-04
DC=CP
WRITE(6,109) CP
READ(2,F5) CP, JV, RHO, XL
901 READ(6,111) (GT(I,J), GOVDR(I,J), I=1,JXV)
WRITE(6,108)
WRITE(6,107) J, GTOW(J), JXA
JXA=J(I,J)
DO 902 J=1,J2
WRITE(6,106) J2
IF (JWRITE.LI.1) GO TO 901
READ(2,F4) (GT(I,J), GOVDR(I,J), I=1,JXA)
900 READ(2,F4) (GT(I,J), GOVDR(I,J), I=1,JXA)
JXA=J(I,J)
DO 902 J=1,J2
WRITE(6,106) J2
IF (JWRITE.LI.1) GO TO 901
READ(2,F3) (J(I,J), J=1,J2)
READ(2,F2) (GTOW(J), J=1,J2)
READ(2,F1) J2, JWRITE, JWI, JWS
READ(2,100) F1, F2, F3, F4, F5, F6, F7, F8, F9, F10
112 FORMAT(IHK,14X,18THE PLUG RADIUS IS,F8.2,4H FT.)
111 FORMAT(IH,14X,6F10.4)
110 FORMAT(IHK,14X,17THE FLOW RATE IS ,F11.8,3X,
110 FORMAT(IHK,14X,17THE FLOW RATE IS ,F11.3,2X,11HBLVDAY OR,)
109 FORMAT(IH,14X,3(20H TIME - SHEAR RATE))
108 FORMAT(IH,14X,3(20H DATA POINTS.))
107 FORMAT(IHK,14X,8FOR TOW(1,2,4H) =,F10.4,11H, THERE ARE,
106 FORMAT(IH,14X,9THERE ARE,13,24H VALUES OF SHEAR STRESS.))
105 FORMAT(IHK,13X,15,2X,2SHEAR AGES ARE CALCULATED.)
104 FORMAT(IHK,14X,28HITS LIMITING SHEAR STRESS IS,F6.3,
104 FORMAT(IHK,14X,28HITS LIMITING SHEAR STRESS IS,F6.3,
103 FORMAT(IHK,14X,27THE DENSITY OF THE FLUID IS,F7.3,
102 FORMAT(IHK,14X,28THE RADIUS OF THE PIPE IS ,F2.5,4H FT.)
101 FORMAT(IHK,14X,28THE AVG. VELOCITY IS THEN,F7.4,
100 FORMAT(12A6)
1 JWS, NT, NNN
INTEGER I, J, J2, J(I30), JXA, JWRITE, JV, N, NMAX, JWI,
2 TT(10), REC, XL, RR, RHO, VA
1 TINIT, TOWMIN, EP21, EP22, EP23, EP24, EP25, EP26, EP2,
REAL GTOW(30), GT(30,30), GOVDR(30,30), CP, QG, RF, DELTA,
1 F7(12), F8(12), F9(12), F10(12)
REAL F(12), F2(12), F3(12), F4(12), F5(12), F6(12),
OF CONDITIONS ON THE SAME FLUID IS READ.
- FLAG INTEGER. IF GREATER THAN ZERO, A NEW SET
NT - NUMBER OF FLOW DURATIONS.
TT( ) - VECTOR OF FLOW DURATIONS TO BE CALCULATED.

```





READ(5,F9) (TT(I), I=1,NT)  
WRITE(6,105) RF  
RR=RF-RA  
WRITE(6,115) RA  
WRITE(6,101) VA  
WRITE(6,103) RHD  
WRITE(6,104) TOWMIN  
WRITE(6,102) NT  
REC=8\*VA\*\*2/RH/32.5  
CALL TIME (TINIT, J2, JT, GTOW, GT, GVDOR, DELTA, GC, N,  
1 NMAX, TOWMIN, RF, EP21, EP22, EP23, EP24, EP25, EP26,  
2 REC, JWS, JWS, TT, NT, EP27, XL, RH)  
READ(5,F10) NNN  
IF (NNN.LT.1) CALL EXIT  
GO TO 901  
END

```

SUBROUTINE INITPR (V1, R1, T, TW, RR, RF, N, JT, JS, GT,
1 GTOW, GDVDR, KOT, Q2, TOWMIN, KA, QG, EPS1, EPS2, NMAX,
2 VZ)

```

```

C 'INITPR' IS CALLED BY 'TIME' AND BY 'LENGTH'.
C 'INITPR' USES GOLDEN INTERVAL ITERATION TO ESTABLISH THE
C CORRECT VALUE OF SHEAR STRESS AT THE WALL IN A PIPE OF
C RADIUS, R, AT A CONSTANT FLOW RATE, QG, FOR A CONSTANT AGE
C MATERIAL. INCREMENTAL FLOW RATES ARE PROVIDED ACCURATELY
C AFTER THE NUMBER OF INCREMENTS HAVE BEEN CONVERGED UPON.

```

# LIST OF SYMBOLS

```

C GDVDR( , )- DATA SHEAR RATES (1/SEC).
C GT( , ) - DATA SHEAR DURATIONS (MIN).
C GTOW( ) - DATA SHEAR STRESSES (LB/SQ FT X 1000).
C JS - NUMBER OF VALUES IN SHEAR STRESS VECTOR AND
C LIMIT OF SECOND SUBSCRIPT OF OTHER TWO
C VARIABLES.
C JT - FIRST SUBSCRIPT LIMIT.
C TW - SHEAR STRESS AT WALL (LB/SQ FT).
C TB - SAME VALUE AT PREVIOUS NUMBER OF INCREMENTS.
C V1( ) - VELOCITY POINTS (FT/SEC).
C R1( ) - RADIAL POSITIONS (FT), MEASURED FROM WALL.
C RF - PIPE RADIUS (FT).
C RA( ) - RADII OF VELOCITY POINTS (FT), RF-R1( ).
C I - INTEGER SPECIFYING RADIAL INCREMENT FROM
C RA(I+1) TO RA(I), NUMBERED FROM WALL.
C Q2( ) - INCREMENTAL FLOW RATE VECTOR (CU FT/SEC).
C N - NUMBER OF RADIAL INCREMENTS.
C NP - NUMBER OF STREAMLINES IN NON-GEL FLOW REGION.
C IA - NUMBER OF INCREMENTS IN NON-GEL REGION.
C S1 - LOWER LIMIT OF GOLDEN INTERVAL SEARCH.
C S2 - UPPER LIMIT OF GOLDEN INTERVAL SEARCH.
C TOWMIN - LIMITING STRESS OF FLUID.
C RR - WIDTH OF NON-PLUG REGION.
C T( ) - FLUID AGE VECTOR AT QUADRATURE POSITIONS (MIN).
C VEL - INCREMENTAL INCREASE IN VELOCITY.
C FQ - INCREMENTAL FLOW RATE.
C QSUM - TOTAL CALCULATED FLOW RATE.
C QG - TOTAL GIVEN FLOW RATE.
C AQD - ABSOLUTE ERROR IN FLOW RATE.
C AAA - PREVIOUS VALUE OF AQD.
C ATD - ERROR IN SHEAR STRESS AT TWO NUMBERS OF RADIAL
C INCREMENTS.
C NMAX - MAXIMUM NUMBER OF RADIAL INCREMENTS ACCEPTABLE
C TO PROGRAMMER.

```

```

REAL V1(35), R1(35), RA(35), Q2(35), T(100), GTOW(30),
1 GT(30,30), GDVDR(30,30), RF, RR, RI, A, B, QSUM, FQ, DR,
2 S1, S2, SA, SB, AQD, AQD1, AQD2, ATD, TB, TW, TOWMIN, QG,
3 EPS1, EPS2, AAA, VZ(100), VEL
INTEGER I, N, NP, IA, I1, KOT, KA, M, NMAX, JT(30), JS, NN
C INITIALIZE PROBLEM.

```



# INITIALIZE PROGRAM.

INTEGER I, N, NP, IA, II, RUT, KA, M, NMAX, JT(30), JS, MW  
 3 EP21, EP22, AAV, V2(100), VEL  
 2 SI, S2, SA, SB, AOD, AOS, ATD, TB, TW, TOWIN, GG,  
 I GT(30,30), GVDK(30,30), RF, RI, A, B, QDM, FD, DR,  
 REAL V1(32), R1(32), RA(32), Q2(32), T1(00), C1W(30),  
 TO PROGRAMMER.

- MAXIMUM NUMBER OF RADIAL INCREMENTS ACCEPTABLE  
 INCREMENTS.

- ERROR IN SHEAR STRESS AT TWO NUMBERS OF RADIAL

AAA - PREVIOUS VALUE OF AOD.

AOD - ABSOLUTE ERROR IN FLOW RATE.

GG - TOTAL GIVEN FLOW RATE.

QDM - TOTAL CALCULATED FLOW RATE.

FD - INCREMENTAL FLOW RATE.

VEL - INCREMENTAL INCREASE IN VELOCITY.

T( ) - FLUID AGE VECTOR AT QUADRATURE POSITION (MIN).

RR - WIDTH OF NON-PLUG REGION.

TOWIN - LIMITING STRESS OF FLUID.

S2 - UPPER LIMIT OF GOLDEN INTERVAL SEARCH.

S1 - LOWER LIMIT OF GOLDEN INTERVAL SEARCH.

IA - NUMBER OF INCREMENTS IN NON-GEL REGION.

NP - NUMBER OF STREAMLINES IN NON-GEL FLOW REGION.

N - NUMBER OF RADIAL INCREMENTS.

Q2( ) - INCREMENTAL FLOW RATE VECTOR (CU FT/SEC).

RAI(1) TO RAI(1), NUMBERED FROM WALL.

I - INTEGER SPECIFYING RADIAL INCREMENT FROM

RAI( ) - RADII OF VELOCITY POINTS (FT), RF-RI( ).

RF - PIPE RADIUS (FT).

RI( ) - RADIAL POSITIONS (FT), MEASURED FROM WALL.

V1( ) - VELOCITY POINTS (FT/SEC).

TB - SAME VALUE AT PREVIOUS NUMBER OF INCREMENTS.

TW - SHEAR STRESS AT WALL (LB/20 FT).

JT - FIRST SUBSCRIPT LIMIT.

VARIABLES.

LIMIT OF SECOND SUBSCRIPT OF OTHER TWO

- NUMBER OF VALUES IN SHEAR STRESS VECTOR AND

Q2 - DATA SHEAR STRESSES (LB/20 FT X 1000).

GT( ) - DATA SHEAR DURATION (MIN).

GVDK( ) - DATA SHEAR RATES (1/SEC).

## LIST OF SYMBOLS

AFTER THE NUMBER OF INCREMENTS HAVE BEEN CONVERGED UPON.

MATERIAL. INCREMENTAL FLOW RATES ARE PROVIDED ACCURATELY

RADIUS, R, AT A CONSTANT FLOW RATE, QG, FOR A CONSTANT AGE

CORRECT VALUE OF SHEAR STRESS AT THE WALL IN A PIPE OF

INITPR, USES GOLDEN INTERVAL ITERATION TO ESTABLISH THE

INITPR, IS CALLED BY TIME, AND BY LENGTH.

S V2)

I GTW, GVDK, KOT, Q2, TOWIN, KA, QG, EP21, EP22, NMAX,  
 SUBROUTINE INITPR (VI, RI, T, TW, RR, RF, N, JT, JS, AT,



```

AQB=0.00
TB=0.00
V1(1)=0.00
RA(1)=RF
R1(1)=0.00
C      INITIATE GOLDEN INTERVAL SEARCH FOR WALL SHEAR STRESS.
M=0
S1=GTOW(1)/1000.
S2=GTOW(JS)/1000.
C      SELECT TRIAL VALUE OF WALL SHEAR STRESS.
11 CALL GOLDIT (M, S1, S2, TW, AQB, SA, SB, AQB1, AQB2)
C      IF NO GEL EXISTS, GO TO 12.
IF (KOT.EQ.0) GO TO 12
C      IF THE PLUG RADIUS HAS BEEN SELECTED, GO TO 9
IF (KOT.EQ.1) GO TO 9
C      CALCULATE WIDTH OF NON-PLUG SECTION.
RR=RF-TOWMIN*RF/TW
C      IF IT IS NEGATIVE GO TO 24.
IF (RR.LE.0.00) GO TO 24
C      ESTABLISH NUMBER OF INCREMENTS IN NON-PLUG REGION.
9 RI=N
RI=RF/RI
IA=RR/RI
IA=IA+1
IF (IA.EQ.N) N=N+1
NP=IA+1
C      DEPLOY RADII PARABOLICALLY.
B=IA
DO 10 I=2,NP
A=NP-I
10 R1(I)=RR*(1.-(A/B)**0.5)
GO TO 14
12 CONTINUE
C      DEPLOY RADII PARABOLICALLY FOR NO-GEL CONDITION.
NP=N+1
IA=N
B=N
DO 13 I=2,NP
A=NP-I
13 R1(I)=RF*(1.-(A/B)**0.5)
14 NN=3*N
C      DEFINE CONSTANT TIME VECTOR.
DO 4 I=1,NN
4 T(I)=T(1)
C      CALCULATE VELOCITY PROFILE.
DO 1 I=2,NP
CALL SINT (JT, JS, GT, GTOW, GDVDR, T, TW, KA, R1, I, VEL,
1 RF)
IF (KA.EQ.1) RETURN
V1(I)=V1(I-1)+VEL
1 RA(I)=RF-R1(I)
C      CALCULATE INCREMENTAL AND TOTAL FLOWS.

```

```

C          CALCULATE INCREMENTAL AND TOTAL FLOWS.
1          R1(I)=R1(I)+VEL
            IF (KA.EQ.1) RETURN
            I (IF)
CALL SINT (JT, JS, CT, GTOW, CDVDR, T, TW, KA, RI, J, VEL,
DO I=1,NP
DO J=1,NP
            CALCULATE VELOCITY PROFILE.
4          T(I)=T(I)
DO 4 I=1,N
            DEFINE CONSTANT TIME VECTOR.
14         IN=3*N
13         R1(I)=R1*(1.-(A\B)**0.5)
            A=NP-I
DO 13 I=1,NP
            B=N
            IA=N
            NP=N+1
            DEPLOY RADII PARABOLICALLY FOR NO-GEL CONDITION.
12         CONTINUE
            GO TO 14
10         R1(I)=R1*(1.-(A\B)**0.5)
            A=NP-I
DO 10 I=1,NP
            B=1A
            DEPLOY RADII PARABOLICALLY.
            NP=1A+1
            IF (1A.EQ.N) N=N+1
            1A=1A+1
            1A=R1\RI
            RI=R1\RI
            RI=N
9          ESTABLISH NUMBER OF INCREMENTS IN NON-PLUG REGION.
            IF (RR.LE.0.00) GO TO 24
            IF IT IS NEGATIVE GO TO 24.
            RR=RF-TOWMIN*RF\TW
            CALCULATE WIDTH OF NON-PLUG SECTION.
            IF (KOT.EQ.1) GO TO 9
            IF THE PLUG RADIUS HAS BEEN SELECTED, GO TO 9
            IF (KOT.EQ.0) GO TO 12
            IF NO GEL EXISTS, GO TO 12.
11         CALL GOLDIT (M, 21, 22, TW, AGU, 2A, 2B, ADD1, ADD2)
            SELECT TRIAL VALUE OF WALL SHEAR STRESS.
            22=GTOW(12)\1000.
            21=GTOW(11)\1000.
            M=0
            INITIATE GOLDEN INTERVAL SEARCH FOR WALL SHEAR STRESS.
            R1(1)=0.00
            RA(1)=RF
            VI(1)=0.00
            TB=0.00
            ADD=0.00

```



```

      QSUM=0.00
      DO 2 I=1,IA
      CALL INTEGR (V1, RA, I, NP, FQ, VZ)
      Q2(I)=FQ
2     QSUM=QSUM+FQ
      IF NO GEL EXISTS, GO TO 22
      IF(KOT.EQ.0) GO TO 22
      DR=N-IA
      SELECT RADII, AND CALCULATE INCREMENTAL FLOW RATES IN
      PLUG REGION.
      DR=(RF-RR)/DR
      DO 21 I=NP,N
      I1=I+1
      V1(I1)=V1(NP)
      R1(I1)=R1(I)+DR
      Q2(I)=3.1415927*(((RF-R1(I))**2-(RF-R1(I1))**2)*V1(NP)
21    QSUM=QSUM+Q2(I)
22    CONTINUE
      AAA=AQD
      CALCULATE FLOW RATE ERROR.
      AQD=ABS((QG-QSUM)/QG)
      IF IT HAS CHANGED FROM ITS PREVIOUS VALUE, GO TO 25.
      IF (ABS(AQD-AAA).GT.1.0E-30) GO TO 25
      NO FURTHER CONVERGENCE POSSIBLE, PRINT OUT LIMIT
      ATTAINED.
      WRITE(6,27) AQD, EPS1
27    FORMAT(1H , 20H THE MINIMUM ERROR IS,E15.8,2X,11H WITH EPS1 =,E15.8
      AQD=1.0E-30
      IF ERROR IS NOT TOLERABLE, REPEAT PROCEDURE.
25    IF(AQD.GT.EPS1) GO TO 11
      CHECK FOR WALL STRESS CONVERGENCE AT TWO INCREMENT SIZES.
      ATD=ABS((TW-TB)/TW)
      PREPARE TO RE-ESTABLISH SHEAR FOR SHEAR STRESS.
      M=0
      S1=(1.-ATD)*TW
      S2=(1.+ATD)*TW
      IF WALL STRESS IS CONVERGED, GO TO 20
      IF(ATD.LT.EPS2) GO TO 20
      IF NUMBER OF ALLOWABLE INCREMENTS IS EXCEEDED, GO TO 20.
      IF (N.GE.NMAX) GO TO 20
      IF NUMBER IS GREATER THAN 32, GO TO 20.
      IF (N.GE.32) GO TO 20
      TB=TW
      INCREASE NUMBER OF INCREMENTS BY 2.
      N=2+N
      GO TO 11
      REDEFINE SEARCH RANGE.
24    M=0
      S1=TW
      GO TO 11
20    RETURN
      END

```

```

END
50 RETURN
GO TO 11
S1=TW
M=0
54 REDEFINE SEARCH RANGE.
GO TO 11
N=5+N
INCREASE NUMBER OF INCREMENTS BY 5.
TB=TW
IF (N.GE.35) GO TO 50
IF NUMBER IS GREATER THAN 35, GO TO 50.
IF (N.GE.NMAX) GO TO 50
IF NUMBER OF ALLOWABLE INCREMENTS IS EXCEEDED, GO TO 50.
IF (ATD.LT.EP21) GO TO 50
IF WALL STRESS IS CONVERGED, GO TO 50
S2=(1.+ATD)*TW
S1=(1.-ATD)*TW
M=0
PREPARE TO RE-ESTABLISH SHEAR FOR SHEAR STRESS.
ATD=ABS((TW-TB)/TW)
CHECK FOR WALL STRESS CONVERGENCE AT TWO INCREMENT SIZES.
IF (ACD.GT.EP21) GO TO 11
IF ERROR IS NOT TOLERABLE, REPEAT PROCEDURE.
ACD=1.0E-30
57 FORMAT(1H, 20THE MINIMUM ERROR IS, E12.8, 2X, 11WITH EP21 =, E
WRITE(6,27) ACD, EP21
ATTAINED.
NO FURTHER CONVERGENCE POSSIBLE, PRINT OUT LIMIT
IF (ABS(AOD-AAA).GT.1.0E-30) GO TO 52
IF IT HAS CHANGED FROM ITS PREVIOUS VALUE, GO TO 52.
AOD=ABS((QD-Q2UM)/QD)
CALCULATE FLOW RATE ERROR.
AAA=AOD
52 CONTINUE
S1 Q2UM=Q2UM+Q2(I)
Q2(I)=3.1415927*((RF-R1(I))*S-(RF-R1(I))*S)*VI(NP)
R1(I)=R1(I)+DR
VI(I)=VI(NP)
I1=I+1
DO S1 I=NP,N
DR=(RF-R1)/DR
PLUG REGION.
SELECT RADII, AND CALCULATE INCREMENTAL FLOW RATES IN
DR=N-1A
IF (KOT.EQ.0) GO TO 52
IF NO GEL EXISTS, GO TO 52
Q2UM=Q2UM+Q2(I)
Q2(I)=FQ
CALL INTEGR (VI, RA, I, NP, FQ, V2)
DO S1 I=1,1A
Q2UM=0.00

```



```

SUBROUTINE INTCON (V, RA, NP, FQ, A, B)
C  'INTCON' IS CALLED BY 'RADII'.
C  'INTCON' FINDS THE VOLUMETRIC FLOW RATE BETWEEN TWO STREAM-
C  LINES USING GAUSSIAN QUADRATURE ON A LAGRANGIAN INTERPOLATED
C  PROFILE.
C
C  LIST OF SYMBOLS
C      V( ) - INPUT VELOCITY PROFILE (FT/SEC) AT
C      RA( ) - SPECIFIED RADII (FT).
C      NP - NUMBER OF POINTS IN PROFILE (NUMBERED FROM
C           WALL).
C      A - INNER STREAMLINE RADIUS (FT).
C      B - OUTER STREAMLINE RADIUS (FT).
C      M - INTEGER SPECIFYING QUADRATURE POINT NUMBER (1
C           TO 3).
C      LAMBDA - QUADRATURE LOCATION ON THE RANGE FROM -1 TO
C              +1.
C      H - WEIGHTING FACTOR ON INTEGRAL AT LAMBDA.
C      X - ACTUAL PIPE RADIUS SPECIFIED BY LAMBDA.
C      I - LOCATION OF X AMONG RA( ) FOR INTERPOLATION
C           POLYNOMIAL.
C      K1 - LOWER EXTENT OF INTERPOLATION POLYNOMIAL.
C      K2 - UPPER EXTENT OF INTERPOLATION POLYNOMIAL.
C      YP - VALUE OF FUNCTION FROM INTERPOLATION
C           POLYNOMIAL.
C      YOFX - PRODUCT OF VELOCITY TIMES RADIUS AT X -
C              REQUIRED INTEGRAL.
C
C      REAL V(35), RA(35), FQ, CONST, H, LAMBDA, X, YOFX, XR, YP,
1  A, B
C      INTEGER NP, M, I, K1, K2, IJ, JJ, J
C      INITIALIZE INTEGRATION.
C      CONST=6.2831853
C      FQ=0.00
C      M=1
C
C      SELECT VALUE OF LAMBDA AND H FOR A GIVEN VALUE OF M.
130  GO TO (131, 132, 133), M
131  LAMBDA=-0.77459667
    H=0.55555555
    GO TO 134
132  LAMBDA=0.00
    H=0.88888888
    GO TO 134
133  LAMBDA=+0.77459667
    H=0.55555555
C      CALCULATE VALUE OF RADIUS CORRESPONDING TO LAMBDA.
134  X=(LAMBDA*(B-A)+A+B)/2.00
C      LOCATE X IN THE VELOCITY PROFILE.
    DO 160 J=1, NP
    I=J
160  IF (X.GT.RA(J)) GO TO 161
C      ESTABLISH RANGE OF THIRD-ORDER POLYNOMIAL.

```

SUBROUTINE INTCON (V, RA, NP, FQ, A, B)  
 INTCON IS CALLED BY RADII.  
 INTCON FINDS THE VOLUMETRIC FLOW RATE BETWEEN TWO STREAM-  
 LINES USING GAUSSIAN QUADRATURE ON A LAGRANGIAN INTERPOLATED  
 PROFILE.

LIST OF SYMBOLS  
 V ( ) - INPUT VELOCITY PROFILE (FT/SEC) AT  
 RA ( ) - SPECIFIED RADIUS (FT).  
 NP - NUMBER OF POINTS IN PROFILE (NUMBERED FROM  
 WALL).  
 A - INNER STREAMLINE RADIUS (FT).  
 B - OUTER STREAMLINE RADIUS (FT).  
 M - INTEGER SPECIFYING QUADRATURE POINT NUMBER (1  
 TO 3).  
 LAMBDA - QUADRATURE LOCATION ON THE RANGE FROM -1 TO  
 +1.  
 H - WEIGHTING FACTOR ON INTEGRAL AT LAMBDA.  
 X - ACTUAL PIPE RADIUS SPECIFIED BY LAMBDA.  
 I - LOCATION OF X AMONG RA ( ) FOR INTERPOLATION  
 POLYNOMIAL.  
 K1 - LOWER EXTENT OF INTERPOLATION POLYNOMIAL.  
 K2 - UPPER EXTENT OF INTERPOLATION POLYNOMIAL.  
 YP - VALUE OF FUNCTION FROM INTERPOLATION  
 POLYNOMIAL.  
 YOPX - PRODUCT OF VELOCITY TIMES RADIUS AT X -  
 REQUIRED INTEGRAL.  
 REAL V(32), RA(32), FQ, CONST, H, LAMBDA, X, YOPX, XR, YP,  
 I, A, B  
 INTEGER NP, M, I, K1, K2, J1, J2  
 INITIALIZE INTEGRATION.  
 CONST=6.2831853  
 FQ=0.00  
 M=1

SELECT VALUE OF LAMBDA AND H FOR A GIVEN VALUE OF M.  
 GO TO (131, 132, 133, 134) M  
 LAMBDA=-0.7745967  
 H=0.2252252  
 GO TO 134  
 LAMBDA=0.00  
 H=0.8888888  
 GO TO 134  
 LAMBDA=+0.7745967  
 H=0.2252252  
 CALCULATE VALUE OF RADIUS CORRESPONDING TO LAMBDA.  
 $X = (LAMBDA * (B - A) + A) / 2.00$   
 LOCATE X IN THE VELOCITY PROFILE.  
 DO 160 J=1, NP  
 I=J  
 IF (X.GT.VA(J)) GO TO 161  
 ESTABLISH RANGE OF THIRD-ORDER POLYNOMIAL.



```

161 K1=I-2
   K2=I+1
C   AT LOW END OF VELOCITY PROFILE MAKE INTERPOLATION
C   LINEAR.
   IF (K1.GE.1) GO TO 165
   K1=1
   K2=2
C   AT TOP OF PROFILE MAKE INTERPOLATION SECOND ORDER AND
C   SYMMETRIC ABOUT PIPE CENTRELINE.
165 IF (K2.LE.NP) GO TO 164
   RA(K2)=-RA(K2-2)
   V(K2)=V(K2-2)
164 CONTINUE
C   CALCULATE INTERPOLATION POLYNOMIAL AND OBTAIN PRODUCT OF
C   VELOCITY * RADIUS.
   YOFX=0.00
   DO 163 IJ=K1,K2
   YP=1.00
   DO 162 JJ=K1,K2
   IF (JJ.EQ.IJ) GO TO 162
   XR=(X-RA(IJ))/(RA(IJ)-RA(JJ))
   YP=YP*XR
162 CONTINUE
163 YOFX=YOFX+V(IJ)*RA(IJ)*YP
C   CALCULATE WEIGHTED PORTION OF INTEGRAL CORRESPONDING
C   TO VALUE OF M.
   FQ=FQ+H*YOFX
C   INCREASE M BY 1 AND CHECK FOR COMPLETION OF INTEGRATION.
   M=M+1
   IF (M.LE.3) GO TO 130
C   CONVERT INTEGRAL ON RANGE -1 TO +1 INTO INTEGRAL ACROSS
C   INCREMENT AND MULTIPLY BY CONST (2*PI) TO YIELD
C   INCREMENTAL FLOW RATE.
   FQ=FQ*CONST*(B-A)/2.00
   RETURN
   END

```

```

161 K1=I-2
KS=I+1
C AT LOW END OF VELOCITY PROFILE MAKE INTERPOLATION
C LINEAR.
IF (K1.GE.1) GO TO 162
K1=1
KS=2
C AT TOP OF PROFILE MAKE INTERPOLATION SECOND ORDER AND
C SYMMETRIC ABOUT PIPE CENTRELINE.
162 IF (KS.LE.NP) GO TO 164
RA(KS)=-RA(KS-2)
V(KS)=V(KS-2)
164 CONTINUE
C CALCULATE INTERPOLATION POLYNOMIAL AND OBTAIN PRODUCT OF
C VELOCITY * RADIUS.
YCFX=0.00
DO 163 J=K1,K2
YP=1.00
DO 162 JJ=K1,K2
IF (JJ.EQ.1) GO TO 162
XR=(X-RA(JJ))/(RA(JJ)-RA(JJ))
YP=YP*XR
CONTINUE
162 YCFX=YCFX+V(JJ)*RA(JJ)*YP
C CALCULATE WEIGHTED PORTION OF INTEGRAL CORRESPONDING
C TO VALUE OF M.
FQ=FQ+H*YCFX
C INCREASE M BY 1 AND CHECK FOR COMPLETION OF INTEGRATION.
M=M+1
IF (M.LE.3) GO TO 130
C CONVERT INTEGRAL ON RANGE -1 TO +1 INTO INTEGRAL ACROSS
C INCREMENT AND MULTIPLY BY CONST (2*PI) TO YIELD
C INCREMENTAL FLOW RATE.
FQ=FQ*CONST*(B-A)\2.00
RETURN
END

```



```

SUBROUTINE GOLDIT (I,Z1,Z2,Z,FZ,ZA,ZB,FZ1,FZ2)
C 'GOLDIT' IS CALLED BY 'INITPR' AND BY 'RADII'.
C 'GOLDIT' SELECTS TRIAL VALUES OF THE INDEPENDANT VARIABLE
C ACROSS A SPECIFIED RANGE SO THAT THE DEPENDANT VARIABLE IS
C MINIMIZED.
C
C LIST OF SYMBOLS
C I - INTEGER SPECIFYING LOCATION OF PREVIOUS SEARCH
C VALUE.
C Z1 - LOWER END OF SEARCH RANGE.
C Z2 - UPPER END OF SEARCH RANGE.
C ZA - LAST SELECTED VARIABLE LEFT OF CENTRE.
C ZB - LAST SELECTED VARIABLE RIGHT OF CENTRE.
C Z - NEW TRIAL VALUE.
C FZ - FUNCTIONAL VALUE AT Z.
C FZ1 - FUNCTIONAL VALUE AT ZA.
C FZ2 - FUNCTIONAL VALUE AT ZB.
REAL FZ, FZ1, FZ2, Z1, Z2, ZA, ZB, Z, D
INTEGER I
DOUBLE PRECISION TAU
C FOR FIRST TRIAL I=0.
TAU = 1.618033989
C IF LEFT-HAND POINT CALCULATED LAST GO TO 304.
IF (I.EQ.3) GO TO 304
C IF RIGHT-HAND POINT CALCULATED LAST GO TO 305.
IF (I.EQ.2) GO TO 305
C IF ONE INITIAL POINT HAS BEEN CALCULATED (LHS),
C CALCULATE SECOND ONE (RHS).
IF (I.EQ.1) GO TO 302
I=1
C SELECT POINT LEFT OF CENTRE (ZA).
301 D=ABS((Z1-Z2)/(TAU**2))
ZA=Z1+D
Z=ZA
RETURN
302 I=2
C SELECT POINT RIGHT OF CENTRE (ZB), STORE F(ZA) AS FZ1.
FZ1=FZ
303 D=ABS((Z1-Z2)/(TAU**2))
ZB=Z2-D
Z=ZB
RETURN
304 FZ1=FZ
GO TO 306
C STORE F(ZB) AS FZ2. IF BOTH DEPENDANT VARIABLES ARE
C EQUAL INITIALIZE THE SEARCH.
305 FZ2=FZ
306 IF (FZ1.NE.FZ2) GO TO 307
I=1
Z1=ZA
Z2=ZB

```



```

308 IF (F21.NE.F22) GO TO 307
305 F22=F21
C EQUAL INITIALIZE THE SEARCH.
C STORE F(2B) AS F22. IF BOTH DEPENDANT VARIABLES ARE
GO TO 306
304 F21=F2
RETURN
303 D=ABS((Z1-Z2)\(TAU*2))
ZB=Z2-D
Z=ZB
RETURN
302 SELECT POINT RIGHT OF CENTRE (ZB), STORE F(ZA) AS F21.
I=2
RETURN
301 D=ABS((Z1-Z2)\(TAU*2))
SELECT POINT LEFT OF CENTRE (ZA).
I=1
IF (1.E0.1) GO TO 302
CALCULATE SECOND ONE (RHS).
IF ONE INITIAL POINT HAS BEEN CALCULATED (LHS),
IF (1.E0.2) GO TO 302
IF RIGHT-HAND POINT CALCULATED LAST GO TO 302.
IF (1.E0.3) GO TO 304
IF LEFT-HAND POINT CALCULATED LAST GO TO 304.
TAU = 1.618033989
FOR FIRST TRIAL I=0.
DOUBLE PRECISION TAU
INTEGER I
REAL F2, F21, F22, Z1, Z2, ZA, ZB, Z, D
F22 - FUNCTIONAL VALUE AT ZB.
F21 - FUNCTIONAL VALUE AT ZA.
F2 - FUNCTIONAL VALUE AT Z.
- NEW TRIAL VALUE.
ZB - LAST SELECTED VARIABLE RIGHT OF CENTRE.
ZA - LAST SELECTED VARIABLE LEFT OF CENTRE.
- UPPER END OF SEARCH RANGE.
Z1 - LOWER END OF SEARCH RANGE.
VALUE.
I - INTEGER SPECIFYING LOCATION OF PREVIOUS SEARCH
LIST OF SYMBOLS
C
C MINIMIZED.
C ACROSS A SPECIFIED RANGE SO THAT THE DEPENDANT VARIABLE IS
C 'GOLDIT' SELECTS TRIAL VALUES OF THE INDEPENDANT VARIABLE
C 'GOLDIT' IS CALLED BY 'INITPR' AND BY 'RADII'.
C SUBROUTINE GOLDIT (I,Z1,Z2,Z,ZA,ZB,F21,F22)

```

```

GO TO 301
C      IF THE RHS IS LOWER THAN LHS DEFINE RANGE TO BE RIGHT OF
C      LH POINT, AND RH POINT BECOMES LH POINT.
307 IF (FZ1.LT.FZ2) GO TO 308
      I=2
      Z1=ZA
      ZA=ZB
      FZ1=FZ2
      GO TO 303
C      IF THE LHS IS LOWER THAN RHS, DEFINE RANGE TO BE LEFT
C      OF RH POINT, AND AND THE LH POINT BECOMES THE RH POINT.
308 I=3
      Z2=ZB
      ZB=ZA
      FZ2=FZ1
      GO TO 301
END

```

```

C
C
307 IF (FZ1.LT.FZ2) GO TO 308
      I=5
      Z1=ZA
      ZA=ZB
      FZ1=FZ2
      GO TO 303
C
C
      IF THE LHS IS LOWER THAN RHS, DEFINE RANGE TO BE LEFT
      OF RH POINT, AND THE LH POINT BECOMES THE RH POINT.
308 I=3
      Z2=ZB
      ZB=ZA
      FZ2=FZ1
      GO TO 301
      END

```



SUBROUTINE INTEGR (V, RA, I, NP, FQ, VZ)

'INTEGR' IS CALLED BY 'INITPR' AND BY 'SUBINT'.

'INTEGR' EMPLOYS GAUSSIAN THREE-POINT QUADRATURE TO PROVIDE AN INCREMENTAL FLOW RATE. LAGRANGIAN THIRD-ORDER INTERPOLATION PROVIDES VALUES OF VELOCITY FROM THE INPUT VELOCITY PROFILE CORRESPONDING TO RADII SELECTED BY QUADRATURE.

#### LIST OF SYMBOLS

I - INCREMENT (NUMBERED FROM THE PIPE WALL) FOR WHICH THE FLOW RATE IS CALCULATED.

RA( ) - RADII OF INPUT PROFILE (FT).

V( ) - VELOCITIES CORRESPONDING TO RA( ) (FT/SEC).

NP - NUMBER OF POINTS IN INPUT PROFILE.

VZ( ) - VELOCITIES AT QUADRATURE LOCATIONS (3 PER INCREMENT).

FQ - INCREMENTAL FLOW RATE (CUBIC FT/SEC).

CONST-  $2 * \pi$ .

A - INCREMENT INNER RADIUS (FT).

B - INCREMENT OUTER RADIUS (FT).

M - INTEGER SPECIFYING QUADRATURE POINT NUMBER ( 1 TO 3).

LAMBDA-QUADRATURE LOCATION ON THE RANGE FROM -1 TO +1.

H - WEIGHTING FACTOR ON INTEGRAL AT LAMBDA.

X - ACTUAL RADIUS SPECIFIED BY LAMBDA.

K1 - LOWER EXTENT OF INTERPOLATION POLYNOMIAL.

K2 - UPPER EXTENT OF INTERPOLATION POLYNOMIAL.

YP - VALUE OF FUNCTION FROM INTERPOLATION POLYNOMIAL.

Y2X - VELOCITY AT X.

YOFX - PRODUCT OF VELOCITY TIMES RADIUS AT X.

REAL V(35), RA(35), FQ, CONST, H, LAMBDA, X, YOFX, XR, YP,  
1 A, B, VZ(100), Y2X

INTEGER NP, M, I, K1, K2, IJ, JJ, II

SPECIFY INCREMENT BOUNDS AND INITIALIZE INTEGRATION.

CONST=6.2831853

B=RA(I)

A=RA(I+1)

FQ=0.00

M=1

SELECT VALUE OF LAMBDA AND H FOR A GIVEN M.

130 GO TO (131, 132, 133), M

131 LAMBDA=-0.77459667

H=0.55555555

GO TO 134

132 LAMBDA=0.00

H=0.88888888

GO TO 134

133 LAMBDA=+0.77459667

H=0.55555555

CALCULATE VALUE OF RADIUS FROM LAMBDA.

134 X=(LAMBDA\*(B-A)+A+B)/2.00

DEFINE INTERPOLATION RANGE.



```

C      DEFINE INTERPOLATION RANGE.
C      134 X=(LAMBDA*(R-A)+A)/2.00
C      CALCULATE VALUE OF RADIUS FROM LAMBDA.
C      133 LAMBDA=+0.7745967
C      GO TO 134
C      H=0.8888888
C      LAMBDA=0.00
C      GO TO 134
C      132 LAMBDA=-0.7745967
C      GO TO 131, 132, 133, 134
C      SELECT VALUE OF LAMBDA AND H FOR A GIVEN M.
C      M=1
C      FG=0.00
C      A=RA(I+1)
C      B=RA(I)
C      CONST=6.2831853
C      SPECIFY INCREMENT BOUNDS AND INITIALIZE INTEGRATION.
C      INTEGER NP, M, I, KI, KS, JJ, JJ, II
C      I A, B, VZ(100), YZX
C      REAL V(32), RA(32), FG, CONST, H, LAMBDA, X, YOFX, XR, YP,
C      YOFX - PRODUCT OF VELOCITY TIMES RADIUS AT X.
C      YZX - VELOCITY AT X.
C      YP - VALUE OF FUNCTION FROM INTERPOLATION POLYNOMIAL.
C      KS - UPPER EXTENT OF INTERPOLATION POLYNOMIAL.
C      KI - LOWER EXTENT OF INTERPOLATION POLYNOMIAL.
C      X - ACTUAL RADIUS SPECIFIED BY LAMBDA.
C      H - WEIGHTING FACTOR ON INTEGRAL AT LAMBDA.
C      LAMBDA-QUADRATURE LOCATION ON THE RANGE FROM -1 TO +1.
C      TO 3).
C      M - INTEGER SPECIFYING QUADRATURE POINT NUMBER ( 1
C      H - INCREMENT OUTER RADIUS (FT).
C      A - INCREMENT INNER RADIUS (FT).
C      CONST= 2 * PI.
C      FG - INCREMENTAL FLOW RATE (CUBIC FT/SEC).
C      INCREMENT).
C      VZ( ) - VELOCITIES AT QUADRATURE LOCATIONS (3 PER
C      NP - NUMBER OF POINTS IN INPUT PROFILE.
C      V( ) - VELOCITIES CORRESPONDING TO RA( ) (FT/SEC).
C      RA( ) - RADIUS OF INPUT PROFILE (FT).
C      WHICH THE FLOW RATE IS CALCULATED.
C      I - INCREMENT (NUMBERED FROM THE PIPE WALL) FOR
C      LIST OF SYMBOLS
C      PROFILE CORRESPONDING TO RADIUS SELECTED BY QUADRATURE.
C      TION PROVIDES VALUES OF VELOCITY FROM THE INPUT VELOCITY
C      AN INCREMENTAL FLOW RATE. LAGRANGIAN THIRD-ORDER INTERPOLA-
C      INTEGR, EMPLOY'S GAUSSIAN THREE-POINT QUADRATURE TO PROVIDE
C      INTEGR, IS CALLED BY 'INTPR', AND BY 'SUBINT'.
C      SUBROUTINE INTEGR (V, RA, I, NP, FG, VZ)

```

```

      K1=I-1
      K2=I+2
C      IF AT PIPE WALL MAKE INTERPOLATION SECOND ORDER.
C      IF (K1.LT.1) K1=1
C      IF AT PIPE CENTRE, MAKE INTERPOLATION SECOND ORDER AND
C      SYMMETRIC ABOUT CENTRE.
      IF (K2.LE.NP) GO TO 160
      K1=I
      RA(K2)=-RA(K2-2)
      V(K2)=V(K2-2)
C      CALCULATE INTERPOLATION POLYNOMIAL AND OBTAIN PRODUCT
C      OF VELOCITY * RADIUS AND VELOCITY AT X.
160  YOFX=0.00
      Y2X=0.00
      DO 163 IJ=K1,K2
      YP=1.00
      DO 162 JJ=K1,K2
      IF (JJ.EQ.IJ) GO TO 162
      XR=(X-RA(IJ))/(RA(IJ)-RA(JJ))
      YP=YP*XR
162  CONTINUE
      Y2X=Y2X+V(IJ)*YP
163  YOFX=YOFX+V(IJ)*RA(IJ)*YP
C      STORE VELOCITY AT X.
      II=3*I-M+1
      VZ(II)=Y2X
C      CALCULATE WEIGHTED PORTION OF INTEGRAL AT M.
      FQ=FQ+H*YOFX
C      INCREASE M BY 1 AND CHECK FOR COMPLETION OF INTEGRATION.
      M=M+1
      IF (M.LE.3) GO TO 130
C      CONVERT INTEGRAL ON RANGE -1 TO +1 INTO INTEGRAL ACROSS
C      INCREMENT AND MULTIPLY BY CONST (2*PI).
      FQ=FQ*CONST*(B-A)/2.00
      RETURN
      END

```



```

      K1=1-I
      K2=1+S
      IF AT PIPE WALL MAKE INTERPOLATION SECOND ORDER.
      IF (K1.LT.1) K1=1
      IF AT PIPE CENTRE, MAKE INTERPOLATION SECOND ORDER AND
      SYMMETRIC ABOUT CENTRE.
      IF (K2.LE.NP) GO TO 160
      K1=1
      RA(K2)=-RA(K2-S)
      V(K2)=V(K2-S)
      CALCULATE INTERPOLATION POLYNOMIAL AND OBTAIN PRODUCT
      OF VELOCITY * RADIUS AND VELOCITY AT X.
      YOFX=0.00
      YSX=0.00
      DO 163 1J=K1,K2
      YP=1.00
      DO 162 1J=K1,K2
      IF (1J.EQ.1J) GO TO 162
      XR=(X-RA(1J))/RA(1J)-RA(1J)
      YP=YP*XR
      CONTINUE
      YSX=YSX+V(1J)*YP
      YOFX=YOFX+V(1J)*RA(1J)*YP
      STORE VELOCITY AT X.
      1I=3*1-M+1
      VZ(1I)=YSX
      CALCULATE WEIGHTED PORTION OF INTEGRAL AT M.
      FQ=FQ+H*YOFX
      INCREASE M BY 1 AND CHECK FOR COMPLETION OF INTEGRATION.
      M=M+1
      IF (M.LE.3) GO TO 160
      CONVERT INTEGRAL ON RANGE -1 TO +1 INTO INTEGRAL ACROSS
      INCREMENT AND MULTIPLY BY CONST (2*PI).
      FQ=FQ*CONST*(B-A)/2.00
      RETURN
      END

```

```

SUBROUTINE INTERB (JX, JY, X, Y, Z, XR, YR, YF, KA)
C 'INTERB' IS CALLED BY 'SINT'.
C 'INTERB' EMPLOYS LAGRANGIAN THIRD-ORDER INTERPOLATION TO
C OBTAIN A VALUE OF SHEAR RATE FOR SPECIFIED VALUES OF SHEAR
C STRESS AND TIME.
C
C LIST OF SYMBOLS
C   Y( ) - DATA VALUES OF SHEAR STRESS * 1000 (LB/SQ FT).
C   L - INTEGER SUBSCRIPT FOR SHEAR STRESS.
C   JX - EXTENT OF L - NUMBER OF SHEAR STRESS VALUES.
C   X( , ) - DATA VALUES OF TIME (MIN).
C   Z( , ) - DATA VALUES OF SHEAR RATE. (1/SEC).
C   K - INTEGER SUBSCRIPT OF TIME AT EACH L.
C   JX( ) - EXTENT OF K AT EACH L.
C   JXA - VALUE OF JX(L).
C   XR - VALUE OF SHEAR STRESS * 1000 AT WHICH SHEAR
C   RATE IS REQUIRED (LB/SQ FT).
C   YR - VALUE OF TIME AT WHICH SHEAR RATE IS REQUIRED
C   (MIN).
C   L1 - LOWER END OF SHEAR STRESS INTERPOLATION RANGE.
C   L2 - UPPER END OF SHEAR STRESS INTERPOLATION RANGE.
C   K1 - LOWER END OF TIME INTERPOLATION RANGE, GIVEN L.
C   K2 - UPPER END OF TIME INTERPOLATION RANGE, GIVEN L.
C   XZ - PARTIAL INTERPOLATION POLYNOMIAL.
C   YP - VALUE OF INTERPOLATION POLYNOMIAL.
C   YT( ) - INTERPOLATED VALUE OF SHEAR RATE AT EACH SHEAR
C   STRESS ( SUBSCRIPTED BY L ).
C   YF - FINAL INTERPOLATED VALUE OF SHEAR RATE.
C   KA - FLAG - IF THE SHEAR STRESS DATA HAVE BEEN
C   EXCEEDED IT IS SET TO 1.
REAL X(30,30), Y(30), Z(30,30), YT(30), XR, YR, YP, YF, XZ
INTEGER JX(30), JY, KA, I, L, L1, L2, K, K1, K2, IK, JK, IL
1, JL, JXA
KA=0
C FIND LOCATION OF INPUT SHEAR STRESS IN DATA.
DO 140 I=1,JY
L=I
140 IF (YR.LT.Y(I))GO TO 141
C DATA IS EXCEEDED.
KA=1
WRITE(6,100)
100 FORMAT(1H ,14X,30HSHEAR STRESS DATA IS EXCEEDED.)
RETURN
C DEFINE INTERPOLATION RANGE.
141 L1=L-2
L2=L+1
C IF AT BOTTOM END OF DATA, LINEARIZE INTERPOLATION WITH
C RESPECT TO SHEAR STRESS.
IF (L1.GT.0) GO TO 142
L1=1
L2=2

```



```

C      IF (LT.0) GO TO 145
C      LI=1
C      IF (LI.GT.0) GO TO 145
C      RESPECT TO SHEAR STRESS.
C      IF AT BOTTOM END OF DATA, LINEARIZE INTERPOLATION WITH
C      L2=L+1
C      L1=L-2
C      DEFINE INTERPOLATION RANGE.
C      RETURN
100  FORMAT(1H,14X,30H$HEAR STRESS DATA IS EXCEEDED.)
      WRITE(6,100)
      KA=1
C      DATA IS EXCEEDED.
140  IF (YR.LT.Y(1))GO TO 141
      L=1
      DO 140 I=1,JY
C      FIND LOCATION OF INPUT SHEAR STRESS IN DATA.
      KA=0
      I , JLA , JXA
      INTEGER JX(30), JY, KA, I, L, L1, L2, K, K1, K2, IK, JK, IL
      REAL X(30,30), Y(30), Z(30,30), YT(30), XR, YR, YP, YF, XZ
C      EXCEEDED IT IS SET TO 1.
      KA - FLAG - IF THE SHEAR STRESS DATA HAVE BEEN
      YF - FINAL INTERPOLATED VALUE OF SHEAR RATE.
      STRESS ( SUBSCRIPTED BY L ).
      YTI ) - INTERPOLATED VALUE OF SHEAR RATE AT EACH SHEAR
      YP - VALUE OF INTERPOLATION POLYNOMIAL.
      XZ - PARTIAL INTERPOLATION POLYNOMIAL.
      K2 - UPPER END OF TIME INTERPOLATION RANGE, GIVEN L.
      K1 - LOWER END OF TIME INTERPOLATION RANGE, GIVEN L.
      L2 - UPPER END OF SHEAR STRESS INTERPOLATION RANGE.
      L1 - LOWER END OF SHEAR STRESS INTERPOLATION RANGE.
      YR - VALUE OF TIME AT WHICH SHEAR RATE IS REQUIRED
      RATE IS REQUIRED (LB\20 FT).
      XR - VALUE OF SHEAR STRESS * 1000 AT WHICH SHEAR
      JXA - VALUE OF JX(L).
      JXI ) - EXTENT OF K AT EACH L.
      K - INTEGER SUBSCRIPT OF TIME AT EACH L.
      ZI , I ) - DATA VALUES OF SHEAR RATE. (1\SEC).
      XI , I ) - DATA VALUES OF TIME (MIN).
      JX - EXTENT OF L - NUMBER OF SHEAR STRESS VALUES.
      L - INTEGER SUBSCRIPT FOR SHEAR STRESS.
      YI ) - DATA VALUES OF SHEAR STRESS * 1000 (LB\20 FT).
C      LIST OF SYMBOLS
C      STRESS AND TIME.
C      OBTAIN A VALUE OF SHEAR RATE FOR SPECIFIED VALUES OF SHEAR
C      INTERB, EMPLOY LAGRANGIAN THIRD-ORDER INTERPOLATION TO
C      INTERB, IS CALLED BY 'SINT'.
C      SUBROUTINE INTERB (JX, JY, X, Y, Z, XR, YR, YK, YF, KA)

```

```

C      IF AT TOP OF DATA, LINEARIZE INTERPOLATION WITH RESPECT
C      TO SHEAR STRESS.
142  IF (L2.LE.JY) GO TO 143
      L1=JY-1
      L2=JY
C      BEGIN CALCULATION OF SHEAR RATE AT EACH SHEAR STRESS
C      IN THE INTERPOLATION RANGE.
143  DO 150 L=L1,L2
      JXA=JX(L)
C      FIND LOCATION OF INPUT TIME IN DATA AT SHEAR STRESS
C      CORRESPONDING TO L.
      DO 144 I=1,JXA
      K=I
144  IF (XR.LT.X(I,L)) GO TO 145
C      UPPER END OF TIME CORRESPONDS TO LIMITING VALUE (I.E.
C      INFINITY).
      XR=X(K,L)
C      DEFINE INTERPOLATION RANGE OF TIME.
145  K1=K-2
      K2=K+1
C      LINEARIZE AT BOTTOM OF TIME DATA.
      IF (K1.GE.1) GO TO 146
      K1=1
      K2=2
C      LINEARIZE AT TOP OF TIME DATA.
146  IF (K2.LE.JXA) GO TO 147
      K1=JXA-1
      K2=JXA
C      CALCULATE INTERPOLATION POLYNOMIAL WITH RESPECT TO TIME
C      ( AT CONSTANT SHEAR STRESS ).
147  YT(L)=0.00
      DO 149 IK=K1,K2
      YP=1.00
      DO 148 JK=K1,K2
      IF (JK.EQ.IK) GO TO 148
      XZ=(XR-X(JK,L))/(X(IK,L)-X(JK,L))
      YP=YP*XZ
148  CONTINUE
149  YT(L)=YT(L)+YP*Z(IK,L)
150  CONTINUE
C      CALCULATE INTERPOLATION POLYNOMIAL FOR SHEAR RATE AT
C      CONSTANT (REQUIRED) TIME.
      YF=0.00
      DO 152 IL=L1,L2
      YP=1.00
      DO 151 JL=L1,L2
      IF (JL.EQ.IL) GO TO 151
      XZ=(YR-Y(JL))/(Y(IL)-Y(JL))
      YP=YP*XZ
151  CONTINUE
C      YF IS THE REQUIRED VALUE OF SHEAR RATE.
152  YF=YF+YP*YT(IL)

```



```

152 YF=YF+YPT(I)
C YF IS THE REQUIRED VALUE OF SHEAR RATE.
151 CONTINUE
YF=YF*X2
X2=(YF-Y(I))\Y(I)-Y(I)
IF (JL.EQ.IL) GO TO 151
DO 151 JL=LI,L2
YF=1.00
DO 152 IL=L1,L2
YF=0.00
CONSTANT (REQUIRED) TIME.
C CALCULATE INTERPOLATION POLYNOMIAL FOR SHEAR RATE AT
150 CONTINUE
Y(I)=Y(I)+YF*X2(I)
149 Y(I)=Y(I)+YF*X2(I)
148 CONTINUE
YF=YF*X2
X2=(X(X(I))-X(I))\X(I)-X(I)
IF (JK.EQ.IK) GO TO 148
DO 148 JK=K1,K2
YF=1.00
DO 149 IK=K1,K2
Y(I)=0.00
147 Y(I)=0.00
C AT CONSTANT SHEAR STRESS )
C CALCULATE INTERPOLATION POLYNOMIAL WITH RESPECT TO TIME
K2=JXA
K1=JXA-1
146 IF (K2.LE.JXA) GO TO 147
LINEARIZE AT TOP OF TIME DATA.
C K2=2
K1=1
145 IF (K1.GE.1) GO TO 146
LINEARIZE AT BOTTOM OF TIME DATA.
C K2=K+1
K1=K-2
144 DEFINE INTERPOLATION RANGE OF TIME.
X=X(K,L)
C INFINITY.
C UPPER END OF TIME CORRESPONDS TO LIMITING VALUE (I.E.
144 IF (X(L,X(I),L)) GO TO 145
K=1
DO 144 I=1,JXA
CORRESPONDING TO L.
C FIND LOCATION OF INPUT TIME IN DATA AT SHEAR STRESS
JXA=JX(L)
143 DO 150 L=L1,L2
IN THE INTERPOLATION RANGE.
C BEGIN CALCULATION OF SHEAR RATE AT EACH SHEAR STRESS
L2=JY
L1=JY-1
142 IF (L2.LE.JY) GO TO 143
TO SHEAR STRESS.
C IF AT TOP OF DATA, LINEARIZE INTERPOLATION WITH RESPECT

```





RETURN

END

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

THE END OF THE WORLD

SUBROUTINE LENGTH (TAGE, TINIT, JT, JS, GT, GTOW, GDVDR,  
 1 TOWMIN, EPS1, EPS2, EPS3, EPS4, EPS5, EPS6, DELTAL, QG, N,  
 2 RF, NJ, TOW, PL, JW, EPS, Q, XL, TJ, RJ, VJ, TT, NT, N2,  
 3 JJT, REN, NMAX)

'LENGTH' IS CALLED BY 'TIME'.

'LENGTH' CALCULATES FLOW PROFILES AND WALL SHEAR STRESS  
 ALONG THE PIPE AT MAXIMUM INPUT FLOW DURATION. BASED ON  
 SHEAR STRESS ACCURACY, THE DISTANCES BETWEEN LONGITUDINAL  
 POSITIONS VARY.

#### LIST OF SYMBOLS

TW - WALL SHEAR STRESS (LB/SQ FT).  
 TB - STORED SHEAR STRESS (LB/SQ FT).  
 TA - STORED SHEAR STRESS (LB/SQ FT).  
 TOW( ) - VECTOR STORAGE OF TW.  
 PL( ) - VECTOR STORAGE OF LONGITUDINAL POINTS.  
 XL - PIPE LENGTH (FT).  
 RF - RADIUS OF PIPE (FT).  
 J - INTEGER DEFINING ABOVE VECTOR.  
 NJ - LIMIT OF J - NUMBER OF POSITIONS IN PIPE.  
 NZ - NUMBER OF QUADRATURE LOCATIONS ACROSS PIPE  
 RADIUS.  
 T( ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
 POINTS (E.G. AT J).  
 TP( ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
 POINTS (E.G. AT J-1).  
 TR( ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
 POINTS (E.G. J-2).  
 VZ( ) - VELOCITY VECTOR AT QUADRATURE POINTS (E.G. J).  
 VP( ) - VELOCITY VECTOR AT QUADRATURE  
 POINTS (E.G. J-1).  
 VR( ) - VELOCITY VECTOR AT QUADRATURE  
 POINTS (E.G. J-2).  
 DELTAL - LONGITUDINAL INCREMENT LENGTH.  
 R1( ) - RADIAL POSITIONS (MEASURED FROM WALL) OF  
 STREAMLINES (AT J).  
 RP( ) - RADIAL POSITIONS (MEASURED FROM WALL) OF  
 STREAMLINES (AT J-1).  
 V1( ) - STREAMLINE VELOCITY (AT J).  
 VVP( ) - STREAMLINE VELOCITY (AT J-1).  
 TT( ) - DURATIONS OF FLOW REQUIRED.  
 NT - NUMBER OF FLOW DURATIONS.  
 TJ( , ) - STARTING AGES FOR CALCULATION AT OTHER FLOW  
 DURATIONS.  
 VJ( , ) - STARTING VELOCITIES FOR SUBSEQUENT  
 CALCULATIONS.  
 RJ( , ) - STREAMLINE RADIAL POSITIONS FOR COMENCEMENT OF  
 SUBSEQUENT FLOW DURATIONS.  
 JJT( ) - INTEGER LOCATION OF CALCULATIONAL STARTING  
 POSITION.

REAL TP(100), TR(100), T(100), PL(50), TOW(50), TW, TB, TA,



REAL TP100), TR100), T100), PL100), TOW100), TW, TB, TA,

3 J11 ) - INTEGER LOCATION OF CALCULATIONAL STARTING  
SUBSEQUENT FLOW DURATION.

RJ1 , ) - STREAMLINE RADIAL POSITIONS FOR COMMENCEMENT OF  
CALCULATIONS.

VJ1 , ) - STARTING VELOCITIES FOR SUBSEQUENT  
DURATIONS.

TJ1 , ) - STARTING AGES FOR CALCULATION AT OTHER FLOW  
DURATIONS.

NT - NUMBER OF FLOW DURATIONS.  
T11 ) - DURATION OF FLOW REQUIRED.

VAP1 ) - STREAMLINE VELOCITY (AT J-1).  
V11 ) - STREAMLINE VELOCITY (AT J).

RP1 ) - RADIAL POSITIONS (MEASURED FROM WALL) OF  
STREAMLINES (AT J-1).

RI1 ) - RADIAL POSITIONS (MEASURED FROM WALL) OF  
DELTA - LONGITUDINAL INCREMENT LENGTH.

VR1 ) - VELOCITY VECTOR AT QUADRATURE  
POINTS (E.G. J-2).

VP1 ) - VELOCITY VECTOR AT QUADRATURE  
POINTS (E.G. J-1).

VZ1 ) - VELOCITY VECTOR AT QUADRATURE POINTS (E.G. J).

TR1 ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
POINTS (E.G. AT J-1).

TP1 ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
POINTS (E.G. AT J).

TI1 ) - VECTOR CONTAINING FLUID AGES AT QUADRATURE  
RADIUS.

NZ - NUMBER OF QUADRATURE LOCATIONS ACROSS PIPE  
LIMIT OF J - NUMBER OF POSITIONS IN PIPE.

J - INTEGER DEFINING ABOVE VECTOR.  
RF - RADIUS OF PIPE (FT).

XL - PIPE LENGTH (FT).  
PL1 ) - VECTOR STORAGE OF LONGITUDINAL POINTS.

TOW1 ) - VECTOR STORAGE OF TW.  
TA - STORED SHEAR STRESS (LB/20 FT).

TB - STORED SHEAR STRESS (LB/20 FT).  
TW - WALL SHEAR STRESS (LB/20 FT).

# LIST OF SYMBOLS

POSITIONS VARY.  
SHEAR STRESS ACCURACY, THE DISTANCES BETWEEN LONGITUDINAL  
ALONG THE PIPE AT MAXIMUM INPUT FLOW DURATION. BASED ON  
LENGTH, CALCULATES FLOW PROFILES AND WALL SHEAR STRESS  
LENGTH, IS CALLED BY TIME.

3 J11, REN, NMAX)

2 RF, NJ, TOW, PL, JW, EP2, Q, XL, TJ, RJ, VJ, TT, NT, NZ,  
1 TOWMIN, EP21, EP22, EP23, EP24, EP25, DELTA, Q, W,  
SUBROUTINE LENGTH (TAGE, TINIT, JT, JS, GT, GTOW, GDOVR,



```

1 P1, EPS, DELTAL, V1(35), R1(35), Q(35), GTOW(30), GT(30,30
2 ), GDVDR(30,30), EPS1, EPS2, EPS3, EPS4, EPS5, EPS6, RZ,
3 TINIT, TAGE, RF, TOWMIN, QG, REN, VP(100), XL, VR(100),
4 VZ(100), RP(35), VVP(35), TT(10), TJ(100,10), RJ(35,10),
5 VJ(100,10)
  INTEGER KR, N, I, J, KL, KJ, JS, JT(30), KA, KOT, NMAX, NP,
1 JW, KB, N1, N2, JJT(10), NT, NNT, NJ, NZ, II
C      INITIALIZE SELECTION OF LENGTH POSITIONS.
  N2=1
  NNT=NT-1
  T(1)=TINIT
  PL(1)=0.00
  KOT=0
C      CALCULATE INITIAL PROFILE AND PRINT IT OUT.
  J=1
  CALL INITPR (V1, R1, T, TW, RZ, RF, N, JT, JS, GT, GTOW,
1 GDVDR, KOT, Q, TOWMIN, KA, QG, EPS1, EPS2, NMAX, VZ)
  NP=N+1
  IF (KA.EQ.1) RETURN
  IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RZ)
  TOW(1)=TW
C      INITIALIZE COUNTERS.
  J=2
  KB=1
  KR=0
  KL=0
  KJ=0
C      STORE VECTORS FOR USE AFTER PROCEEDING TWO POSITIONS.
  NZ=3*N
300 DO 301 I=1,NZ
  VR(I)=VZ(I)
301 TR(I)=T(I)
C      STORE VECTORS FOR USE AFTER PROCEEDING ONE POSITION.
302 DO 303 I=1,NZ
  VP(I)=VZ(I)
303 TP(I)=T(I)
C      DEFINE POSITION ALONG PIPE.
304 PL(J)=PL(J-1)+DELTAL
C      CHECK TO SEE IF TOTAL LENGTH HAS BEEN ENCOUNTERED.
  IF (PL(J).LT.(XL-0.001)) GO TO 315
  KB=0
  PL(J)=XL
315 CONTINUE
C      CALCULATE PROFILE AT DEFINED POSITION.
  CALL OPTIM (TAGE, TINIT, JT, JS, GT, GTOW, GDVDR, EPS3,
1 EPS4, EPS5, QG, Q, RF, R1, VP, TW, PL, J, T, TP, KR, N,
2 V1, EPS6, VZ)
C      IF MINIMUM LENGTH IS KNOWN, GO TO 310.
  IF (KJ.GT.0) GO TO 310
C      IF KL = 0, PREPARE TO CUT TEST LENGTH IN TWO.
  IF (KL.GT.0) GO TO 306

```



```

IF (KL.GT.0) GO TO 308
IF KL = 0, PREPARE TO CUT TEST LENGTH IN TWO.
IF (KJ.GT.0) GO TO 310
IF MINIMUM LENGTH IS KNOWN, GO TO 310.
2 VI, EP24, VZ)
1 EP24, EP25, Q, RF, RI, VP, TW, PL, J, T, IP, KR, N,
CALL OPTIM (TAG, TINIT, JT, JS, GT, GROW, GROWR, EP23,
CALCULATE PROFILE AT DEFINED POSITION.
312 CONTINUE
PLJ)=XL
KB=0
IF (PLJ).LT.(XL-0.001) GO TO 315
CHECK TO SEE IF TOTAL LENGTH HAS BEEN ENCOUNTERED.
304 PLJ)=PLJ-1)+DELTA
DEFINE POSITION ALONG PIPE.
303 TRJ)=TJ)
VPJ)=VZJ)
DO 303 I=1,NZ
STORE VECTORS FOR USE AFTER PRECEDING ONE POSITION.
302 DO 303 I=1,NZ
TRJ)=TJ)
VPJ)=VZJ)
DO 303 I=1,NZ
STORE VECTORS FOR USE AFTER PRECEDING TWO POSITIONS.
300 DO 301 I=1,NZ
N3=3*N
315 CONTINUE
N3=3*N
STORE VECTORS FOR USE AFTER PRECEDING TWO POSITIONS.
KJ=0
KL=0
KR=0
KB=1
J=2
INITIALIZE COUNTERS.
TOWJ)=TW
1 Q, T, REN, KOT, RZ)
IF (JW.GT.0) CALL WRITE1 (TAG, RF, TW, J, PL, N, RI, VI,
IF (KA.EQ.1) RETURN
NP=NP+1
1 GROWR, KOT, G, TOWMIN, KA, G, EP21, EP22, NMAX, VZ)
CALL INITPR (VI, RI, T, TW, RZ, RF, N, JT, JS, GT, GROW,
J=1
CALCULATE INITIAL PROFILE AND PRINT IT OUT.
KOT=0
PLJ)=0.00
TJ)=TINIT
NNT=NT-1
N3=1
INITIALIZE SELECTION OF LENGTH POSITIONS.
1 JW, KB, NT, N3, JT(10), NT, NNT, N3, N3, II
INTEGER KR, N, I, J, KL, KJ, JS, JT(30), KA, KOT, NMAX, NP,
2 VJ(100,10)
4 VZ(100), R(135), V(135), TJ(10), TJ(100,10), R(135,10),
3 TINIT, TAG, RF, TOWMIN, G, REN, V(100), XL, V(100),
2 G, GROWR(30,30), EP21, EP22, EP23, EP24, EP25, RZ,
1 RI, EP2, DELTA, V(135), R(135), Q(35), GROW(30), GT(30,30)

```

```

C      HALVE INCREMENT, STORE SHEAR STRESS.
305  TA=TW
      DELTAL=DELTAL/2.0
      KL=1
      TW=TOW(1)
      GO TO 304
C      IF KL = 1, FIRST SEGMENT OF TEST LENGTH HAS BEEN
C      CALCULATED.
306  IF (KL.GT.1) GO TO 307
C      STORE QUANTITIES FOR PRINT OUT.
      DO 18 I=1,NP
      RP(I)=R1(I)
      18  VVP(I)=V1(I)
      TB=TW
      KL=2
      J=3
      GO TO 302
C      CALCULATE CHANGE IN SHEAR STRESS OVER TEST LENGTH
C      FOR HALF-STEPS.
307  IF ((ABS(TW-TA)/TW).LT.EPS) GO TO 309
C      ERROR IS GREATER THAN EPS, USE PRESENT INCREMENT LENGTH
C      AS TEST SIZE.
      J=2
      DO 308 I=1,NZ
      VP(I)=VR(I)
      308  TP(I)=TR(I)
      GO TO 305
C      ERROR IS LESS THAN EPS, MINIMUM LENGTH IS FOUND AND
C      INCREMENT LENGTH IS DOUBLED.
309  DELTAL=DELTAL*2.00
      TOW(2)=TB
      TOW(3)=TW
      J=2
C      CHECK FOR CALCULATION STARTING POINT OF OTHER FLOW
C      DURATIONS AFTER FIRST PROFILE.
      N1=N2
      DO 316 II=N1,NNT
      IF (TP(1).LT.(TT(II)+TINIT)) GO TO 316
      JJT(II)=J
      DO 317 I=1,NZ
      TJ(I,II)=TR(I)
      317  VJ(I,II)=VR(I)
      DO 322 I=1,NP
      322  RJ(I,II)=RP(I)
      N2=II+1
      316  CONTINUE
C      PRINT OUT SECOND PROFILE.
      IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TB, J, PL, N, RP, VVP,
1  Q, TP, REN , KOT, RZ)
      J=3
C      CHECK FOR CALCULATION STARTING POINT OF OTHER
C      FLOW DURATIONS AFTER SECOND PROFILE.

```



```

C
C FLOW DURATIONS AFTER SECOND PROFILE.
C
C CHECK FOR CALCULATION STARTING POINT OF OTHER
C 1 0, TP, REN, KOT, RX)
IF (JH.GT.0) CALL WRITER (TAGE, RF, TG, J, PL, H, RP, VVP,
PRINT OUT SECOND PROFILE.
C
316 CONTINUE
NS=I+1
352 RJ(I,1)=RP(I)
DO 355 I=1,NP
VJ(I,1)=VR(I)
TJ(I,1)=TR(I)
DO 317 I=1,N5
JJI(I)=J
IF (TP(I).LT.(TJ(I)+TINI)) GO TO 316
DO 316 I=1,NINT
NI=NS
C
C DURATIONS AFTER FIRST PROFILE.
C
C CHECK FOR CALCULATION STARTING POINT OF OTHER FLOW
C
J=5
TCW(3)=TW
TCW(2)=TB
309 DELTA=DELTA*5.00
C
C INCREMENT LENGTH IS DOUBLED.
C
C ERROR IS LESS THAN EPS, MINIMUM LENGTH IS FOUND AND
C GO TO 302
308 TP(I)=TR(I)
VP(I)=VR(I)
DO 308 I=1,N5
J=5
C
C AS TEST SIZE.
C
C ERROR IS GREATER THAN EPS, USE PRESENT INCREMENT LENGTH
C
IF ((ABS(TW-TA)/TW).LT.EPS) GO TO 309
FOR HALF-STEPS.
C
C CALCULATE CHANGE IN SHEAR STRESS OVER TEST LENGTH
C GO TO 305
J=3
KL=5
TB=TW
18 VVP(I)=VI(I)
RP(I)=RI(I)
DO 18 I=1,NP
STORE QUANTITIES FOR PRINT OUT.
C
306 IF (KL.GT.1) GO TO 307
C
C CALCULATED.
C
IF KL = 1, FIRST SEGMENT OF TEST LENGTH HAS BEEN
C GO TO 304
TW=TOW(I)
KL=1
DELTA=DELTA\5.0
TA=TW
C
C HALVE INCREMENT, STORE SHEAR STRESS.

```

```

N1=N2
DO 318 II=N1,NNT
IF (T(1).LT.(TT(II)+TINIT)) GO TO 318
JJT(II)=J
DO 319 I=1,NZ
TJ(I,II)=TP(I)
319 VJ(I,II)=VP(I)
DO 323 I=1,NP
323 RJ(I,II)=R1(I)
N2=II+1
318 CONTINUE
C PRINT THIRD PROFILE.
IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RZ)
KJ=1
KL=0
J=4
GO TO 300
C IF END OF PIPE HAS BEEN REACHED, GO TO 314.
310 IF (KR.GT.0) GO TO 314
C IF FLUID HAS COMPLETELY AGED (ACCORDING TO FLOW
C DURATION), GO TO 314.
IF (KB.LT.1) GO TO 314
C IF INCREMENT HAS BEEN DOUBLED, GO TO 313.
IF (KL.GT.1) GO TO 313
C STORE SHEAR STRESS.
TOW(J)=TW
C CHECK FOR CALCULATION STARTING POINT OF OTHER
C FLOW DURATIONS.
IF (N2.GT.NNT) GO TO 325
N1=N2
DO 320 II=N1,NNT
IF (T(1).LT.(TT(II)+TINIT)) GO TO 320
JJT(II)=J
DO 321 I=1,NZ
TJ(I,II)=TP(I)
321 VJ(I,II)=VP(I)
DO 324 I=1,NP
324 RJ(I,II)=R1(I)
N2=II+1
320 CONTINUE
325 CONTINUE
C PRINT OUT PROFILE.
IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RZ)
C IF KL = 0, FIRST SEGMENT IS CALCULATED.
IF (KL.GT.0) GO TO 311
C PREPARE TO CALCULATE SECOND SEGMENT.
J=J+1
KL=1
GO TO 302
C SECOND SEGMENT IS CALCULATED.

```



```

C      SECOND SEGMENT IS CALCULATED.
      GO TO 305
      KL=1
      J=J+1
      PREPARE TO CALCULATE SECOND SEGMENT.
      IF (KL.GT.0) GO TO 311
      IF KL = 0, FIRST SEGMENT IS CALCULATED.
      I Q, T, REN, KOT, RZ)
      IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, RI, VI,
C      PRINT OUT PROFILE.
329 CONTINUE
330 CONTINUE
      NS=11+1
      RJ1(I,1)=RI(I)
      DO 324 I=1,NP
      VJ1(I,1)=VP(I)
      TJ1(I,1)=TP(I)
      DO 321 I=1,NZ
      JJ1(I)=J
      IF (T(I).LT.(TT(I)+TINIT)) GO TO 320
      DO 320 I=1,NNT
      NI=NS
      IF (NS.GT.NNT) GO TO 322
      FLOW DURATIONS.
      CHECK FOR CALCULATION STARTING POINT OF OTHER
      TOW(J)=TW
      STORE SHEAR STRESS.
      IF (KL.GT.1) GO TO 313
      IF INCREMENT HAS BEEN DOUBLED, GO TO 313.
      IF (K8.LT.1) GO TO 314
      DURATION), GO TO 314.
      IF FLUID HAS COMPLETELY AGED (ACCORDING TO FLOW
      IF (KR.GT.0) GO TO 314
      IF END OF PIPE HAS BEEN REACHED, GO TO 314.
      GO TO 300
      J=4
      KL=0
      KJ=1
      I Q, T, REN, KOT, RZ)
      IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, RI, VI,
C      PRINT THIRD PROFILE.
318 CONTINUE
      NS=11+1
      RJ1(I,1)=RI(I)
      DO 323 I=1,NP
      VJ1(I,1)=VP(I)
      TJ1(I,1)=TP(I)
      DO 319 I=1,NZ
      JJ1(I)=J
      IF (T(I).LT.(TT(I)+TINIT)) GO TO 318
      DO 318 I=1,NNT
      NI=NS

```

```

311  P1=PL(J-1)
C      DOUBLE INCREMENT SIZE FOR CONVERGENCE TEST.
      DELTAL=DELTAL*2.00
      DO 312 I=1,NZ
C      REDEFINE STORED VECTORS.
      VP(I)=VR(I)
312  TP(I)=TR(I)
      J=J-1
      KL=2
      GO TO 304
313  PL(J)=P1
      J=J+2
      KL=0
C      CHECK SHEAR STRESS ERROR AFTER CALCULATION AT TWO
C      INCREMENT SIZES.
      IF (ABS((TOW(J-1)-TW)/TOW(J-1)).LT.EPS) GO TO 300
C      RETAIN SMALLER INCREMENT.
      DELTAL=DELTAL/2.00
      GO TO 300
314  NJ=J
      TOW(NJ)=TW
C      PRINT OUT FINAL PROFILE.
      IF (JW.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RZ)
C      IF END OF PIPE WAS NOT REACHED, DEFINE THIS POINT.
      IF (PL(NJ).GE.(XL-0.0001)) RETURN
      NJ=NJ+1
      PL(NJ)=XL
      TOW(NJ)=TOW(NJ-1)
      RETURN
      END

```



```

311      PI=PI(J-1)
      C      DOUBLE INCREMENT SIZE FOR CONVERGENCE TEST.
      DELTA=DELTA*2.00
      DO 312 I=1,N2
      C      REDEFINE STORED VECTORS.
      VP(I)=VR(I)
      TP(I)=TR(I)
      J=J-1
      KL=2
      GO TO 304
313      PI(J)=PI
      J=J+2
      KL=0
      C      CHECK SHEAR STRESS ERROR AFTER CALCULATION AT TWO
      C      INCREMENT SIZES.
      IF (ABS(TOW(J-1)-TOW(J-1)).LT.EPS) GO TO 300
      C      RETAIN SMALLER INCREMENT.
      DELTA=DELTA\2.00
      GO TO 300
314      NJ=J
      TOW(NJ)=TW
      C      PRINT OUT FINAL PROFILE.
      IF (JH.GT.0) CALL WRITE1 (IAGE, RP, TW, J, PI, NJ, VI,
      I G, T, REN, KOT, RZ)
      C      IF END OF PIPE WAS NOT REACHED, DEFINE THIS POINT.
      IF (PI(NJ).GE.(XL-0.0001)) RETURN
      NJ=NJ+1
      PI(NJ)=XL
      TOW(NJ)=TOW(NJ-1)
      RETURN
      END

```

```

SUBROUTINE OPTIM (TAGE, TINIT, JT, JS, GT, GTOW, GDVDR,
1 EPS3, EPS4, EPS5, QG, Q, RF, R1, VP, TW, PL, J, T, TP, KR,
2 N, V1, EPS6, VR)
C 'OPTIM' IS CALLED BY 'LENGTH' AND BY 'TIME'
C 'OPTIM' CONVERGES WALL SHEAR STRESS, FLUID AGES, RADII, AND
C VELOCITIES, GIVEN THE PREVIOUS AGE AND VELOCITY PROFILES.
C
C LIST OF SYMBOLS
C PL( ) - VECTOR MEASURING POSITION ALONG PIPE (FT).
C J - INTEGER SPECIFYING POSITION.
C TP( ) - PREVIOUS AGE PROFILE (MIN) AT QUADRATURE
C LOCATIONS.
C VP( ) - PREVIOUS VELOCITY PROFILE (FT/SEC) AT
C QUADRATURE LOCATIONS.
C R1( ) - RADIAL POSITION (MEASURED FROM WALL)
C AT EDGES OF STREAMLINES.
C T( ) - AGE PROFILE AT PRESENT PIPE POSITION.
C TA( ) - PREVIOUS TRIAL VALUE OF T( ).
C VR( ) - VELOCITY PROFILE AT PRESENT PIPE POSITION.
C QG - GIVEN VALUE OF FLOW RATE (CU FT/SEC).
C QE - ERROR IN CALCULATED FLOW RATE.
C QO - INITIAL VALUE OF QE.
C TW - WALL SHEAR STRESS (LB/SQ FT).
C TO - INITIAL VALUE OF TW.
C TB - PREVIOUS CONVERGENT VALUE OF TW.
C TAGE - DURATION OF FLOW (MIN).
C TINIT - AGE OF FLUID AT PIPE ENTRANCE.
REAL GTOW(30), GT(30,30), GDVDR(30,30), Q(35), T(100),
1 TP(100), R1(35), VP(100), PL(50), V1(35), Q2(35), QG,
2 RF, C1, TAGE, QE, QO, TW, TB, EPS3, EPS4, EPS5, EPS6, TR,
3 VR(100), TA(100), TINIT
INTEGER N, JS, JT(30), KR, J, NP, NN, I
C INITIALIZE FOR ITERATION AT POSITION J.
C1=(PL(J)-PL(J-1))/60.
NP=N+1
NN=3*N
TB=0.00
C DEFINE NEW AGES FROM PREVIOUS PROFILE.
DO 111 I=1,NN
T(I)=C1/VP(I)+TP(I)
IF (TP(I).GT.(TAGE+1.0E-07)) GO TO 111
IF (TP(I).GT.(TAGE-1.0E-07)) T(I)=TAGE
111 CONTINUE
C CALCULATE FLOW RATE ERROR FROM PREVIOUS VALUE OF SHEAR
C STRESS.
112 CALL SUBINT (JT, JS, GT, GTOW, GDVDR, T, TW, N, RF, R1, V1,
1 QG, QO, Q2, VR)
TO=TW
C SELECT NEW VALUE OF SHEAR STRESS BASED ON ERROR.
TW=TW*(1.0+QO*0.1)
C SHEAR STRESS CANNOT BE NEGATIVE.

```



```

SHEAR STRESS CANNOT BE NEGATIVE.
TW=TW*(1.0+GO*0.1)
SELECT NEW VALUE OF SHEAR STRESS BASED ON ERROR.
TO=TW
CALL SUBINT (JT, JS, GT, GTOW, GOVDR, T, TW, N, RF, RI, VI,
I GO, GO, QS, VR)
112
CALL SUBINT (JT, JS, GT, GTOW, GOVDR, T, TW, N, RF, RI, VI,
STRESS.
111
CONTINUE
IF (TP(I).GT.(TAGE-1.0E-07)) T(I)=TAGE
IF (TP(I).GT.(TAGE+1.0E-07)) GO TO 111
T(I)=CIVP(I)+TP(I)
DO 111 I=1,N
DO 111 I=1,N
DEFINE NEW AGES FROM PREVIOUS PROFILE.
TB=0.00
NM=3*N
NP=N+1
CI=(PL(3)-PL(3-1))/60.
INITIALIZE FOR ITERATION AT POSITION 1.
INTEGER N, JS, JT(30), KR, J, NP, NM, I
3 VR(100), TA(100), TINIT
2 RF, CI, TAGE, QE, GO, TW, TB, EP23, EP24, EP25, EP26, TR,
1 TP(100), RI(35), VP(100), PL(50), VI(35), QS(35), GO,
REAL GTOW(30), GT(30,30), GOVDR(30,30), Q(35), T(100),
TINIT - AGE OF FLUID AT PIPE ENTRANCE.
TAGE - DURATION OF FLOW (MIN).
TB - PREVIOUS CONVERGENT VALUE OF TW.
TD - INITIAL VALUE OF TW.
TW - WALL SHEAR STRESS (LB/20 FT).
GO - INITIAL VALUE OF QE.
QE - ERROR IN CALCULATED FLOW RATE.
GO - GIVEN VALUE OF FLOW RATE (CU FT/SEC).
VR(I) - VELOCITY PROFILE AT PRESENT PIPE POSITION.
TA(I) - PREVIOUS TRIAL VALUE OF T(I).
TI(I) - AGE PROFILE AT PRESENT PIPE POSITION.
AT EDGES OF STREAMLINES.
RI(I) - RADIAL POSITION (MEASURED FROM WALL)
QUADRATURE LOCATIONS.
VR(I) - PREVIOUS VELOCITY PROFILE (FT/SEC) AT
LOCATIONS.
TP(I) - PREVIOUS AGE PROFILE (MIN) AT QUADRATURE
J - INTEGER SPECIFYING POSITION.
PL(I) - VECTOR MEASURING POSITION ALONG PIPE (FT).
LIST OF SYMBOLS
VELOCITIES, GIVEN THE PREVIOUS AGE AND VELOCITY PROFILES.
OPTIM, CONVERGES WALL SHEAR STRESS, FLUID AGES, RADII, AND
OPTIM, IS CALLED BY LENGTH, AND BY TIME,
S N, VI, EP26, VR)
1EP23, EP24, EP25, QE, Q, RF, RI, VR, TW, PL, J, T, TP, KR,
SUBROUTINE OPTIM (TAGE, TINIT, JT, JS, GT, GTOW, GOVDR,

```

```

      IF (TW.LT.0.00) TW=0.00
C      CALCULATE FLOW RATE ERROR.
113 CALL SUBINT (JT, JS, GT, GTOW, GDVDR, T, TW, N, RF, R1, V1,
      1 QG, QE, Q2, VR)
C      IF ERROR IS TOLERABLE GO TO 114.
C      IF (ABS(QE).LT.EPS5) GO TO 114
C      CALCULATE NEW SHEAR STRESS TRIAL VIA REGULI-FALSI.
      TW=TW-QE*(TW-T0)/(QE-Q0)
      GO TO 113
C      RECOMPUTE PRESENT AGE PROFILE.
114 CONTINUE
      DO 115 I=1,NN
      TA(I)=T(I)
      T(I)=C1*2./(VR(I)+VP(I))+TP(I)
C      THE AGE PROFILE CANNOT EXCEED FLOW AGE.
      IF(TP(I).GT.(TAGE+1.0E-07))GO TO 118
      IF (TP(I).GT.(TAGE-1.0E-07)) GO TO 119
      GO TO 118
119 T(I)=TAGE
      GO TO 115
118 IF(T(I).LT.(TAGE+TINIT))GO TO 115
      IF (I.EQ.NN) KR=1
      T(I)=TAGE
115 CONTINUE
C      IF AGE AT THE WALL IS NOT CONVERGED, GO TO 112.
      IF ((ABS(TA(1)-T(1))/T(1)).GT.EPS4) GO TO 112
C      HAS SHEAR STRESS CONVERGED FOR A CHANGE IN RADII.
      IF ((ABS(TW-TB)/TW).LT.EPS6) GO TO 117
      KR=0
      TB=TW
C      CHANGE RADII TO AGREE WITH INCREMENTAL FLOW RATES.
      CALL RADII (V1, R1, N, RF, Q, EPS3)
      GO TO 112
C      DEFINE AGE VECTOR AT LAST VALUE OF SHEAR STRESS.
117 DO 116 I=1,NN
116 T(I)=TA(I)
      RETURN
      END

```



```

      IF (TW.LT.0.00) TW=0.00
      CALCULATE FLOW RATE ERROR.
      CALL SUBINT (JT, J2, GT, GTW, GDVDR, T, TW, N, RT, RI, VI,
113      I Q, Q2, VR)
      IF ERROR IS TOLERABLE GO TO 114.
      IF (ABS(WE).LT.EP22) GO TO 114
      CALCULATE NEW SHEAR STRESS TRIAL VIA REGULI-FALSI.
      TW=TW-Q2*(TW-T0)/(Q2-Q0)
      GO TO 113
      RECOMPUTE PRESENT AGE PROFILE.
      CONTINUE
114      DO 115 I=1,N
      T(I)=T(I)
      T(I)=C1*2.*(VR(I)+VR(I))+TR(I)
      THE AGE PROFILE CANNOT EXCEED FLOW AGE.
      IF (TR(I).GT.(TAGE+1.0E-07)) GO TO 118
      IF (TR(I).GT.(TAGE-1.0E-07)) GO TO 119
      GO TO 118
      T(I)=TAGE
      GO TO 115
118      IF (I.EQ.N) KR=1
      T(I)=TAGE
      CONTINUE
115      IF AGE AT THE WALL IS NOT CONVERGED, GO TO 115.
      IF ((ABS(TA(I)-T(I))\T(I)).GT.EP24) GO TO 115
      HAS SHEAR STRESS CONVERGED FOR A CHANGE IN RADII.
      IF ((ABS(TW-TB)\TW).LT.EP26) GO TO 117
      KR=0
      TB=TW
      CHANGE RADII TO AGREE WITH INCREMENTAL FLOW RATES.
      CALL RADII (VI, RI, N, RF, Q, EP23)
      GO TO 115
      DEFINE AGE VECTOR AT LAST VALUE OF SHEAR STRESS.
      DO 116 I=1,N
      T(I)=TA(I)
116      RETURN
      END

```

```

SUBROUTINE RADII (V1, R1, N, RF, Q, EPS)
C 'RADII' IS CALLED BY 'OPTIM'.
C 'RADII' SHIFTS STREAMLINE RADII SO THAT THE INCREMENTAL FLOW
C RATES AGREE WITH PREVIOUSLY DEFINED VALUES USING GOLDEN
C INTERVAL ITERATION AND REGULI-FALSI INTERATION.
C
C LIST OF SYMBOLS
C V1( ) - VELOCITY OF STREAMLINES (FT/SEC).
C R1( ) - RADIAL POSITION OF STREAMLINES (MEASURED FROM
C WALL).
C NP - NUMBER OF STREAMLINES.
C N - NUMBER OF INCREMENTS.
C R( ) - NEWLY CALCULATED RADII (FT).
C RA( ) - OLD VALUES OF RADIUS (FT).
C Q( ) - INCREMENTAL FLOW RATES (CU FT/SEC).
C RF - RADIUS OF PIPE (FT).
C A - TRIAL RADIUS (FT).
C FQ - INCREMENTAL FLOW RATE AT A (CU FT/SEC).
C QA - ERROR IN FLOW RATE ASSOCIATED WITH A.
C QB - PREVIOUS VALUE OF QA.
C EPS - MAXIMUM ALLOWABLE VALUE OF QA THAT TERMINATES
C A SEARCH FOR A.
C B1 - LOWER LIMIT OF A FOR GOLDEN INTERVAL SEARCH.
C B2 - UPPER LIMIT OF A FOR GOLDEN INTERVAL SEARCH.
C O - LOWER LIMIT OF A FOR REGULI-FALSI SEARCH.
C QO - VALUE OF QA AT O.
C REAL V1(35), R1(35), RA(35), R(35), Q(35), RF, A, QA, QO,
1 EPS, FQ, O, B1, B2, SB1, SB2, QB1, QB2, QB, RZ
C INTEGER I, I1, N, N1, NP, M
C DEFINE LIMITS AND CHANGE RADIAL POSITIONS TO RADII.
NP=NP+1
R(NP)=0.00
R(1)=RF
QO=-1.00
DO 10 I=1,NP
10 RA(I)=RF-R1(I)
C INITIALIZE GOLDEN INTERVAL SEARCH FOR INCREMENT NEAREST
C THE PIPE WALL
I=1
QA=0.00
M=0
I1=I+1
RZ=R(I)
B1=RA(I+2)
B2=R(I)
C SELECT TRIAL VALUE OF A.
9 CALL GOLDIT (M, B1, B2, A, QA, SB1, SB2, QB1, QB2)
C CALCULATE INCREMENTAL FLOW RATE FROM A TO RZ.
CALL INTCON (V1, RA, NP, FQ, A, RZ)
QB=QA
C CALCULATE ERROR IN INCREMENTAL FLOW RATE.

```



```

C      CALCULATE ERROR IN INCREMENTAL FLOW RATE.
C      QH=QA
C      CALL INTCON (VI, RA, NP, FQ, A, RZ)
C      CALCULATE INCREMENTAL FLOW RATE FROM A TO RZ.
C      CALL GOLDIT (M, G1, B2, A, QA, SBI, SBS, DB1, DB2)
C      SELECT TRIAL VALUE OF A.
C      B2=Q(I)
C      B1=RA(I+S)
C      RZ=R(I)
C      I1=I+1
C      M=0
C      QA=0.00
C      I=1
C      THE PIPE WALL
C      INITIALIZE GOLDEN INTERVAL SEARCH FOR INCREMENT NEAREST
C      TO
C      RA(I)=RF-R(I)
C      DO 10 I=1,NP
C      GO=-1.00
C      R(I)=RF
C      R(NP)=0.00
C      NP=NP+1
C      DEFINE LIMITS AND CHANGE RADIAL POSITIONS TO RADII.
C      INTEGER I, I1, N, NI, NP, M
C      I=PS, FQ, O, B1, B2, SBI, SBS, DB1, DB2, DB3, DB4, B5
C      REAL VI(32), RI(32), RA(32), R(32), R1(32), RF, A, QA, QG,
C      QG0
C      - VALUE OF QA AT Q.
C      Q - LOWER LIMIT OF A FOR GOLDEN INTERVAL SEARCH.
C      B2 - UPPER LIMIT OF A FOR GOLDEN INTERVAL SEARCH.
C      B1 - LOWER LIMIT OF A FOR GOLDEN INTERVAL SEARCH.
C      A SEARCH FOR A.
C      EPS - MAXIMUM ALLOWABLE VALUE OF QA THAT TERMINATES
C      - PREVIOUS VALUE OF QA.
C      QA - ERROR IN FLOW RATE ASSOCIATED WITH A.
C      FQ - INCREMENTAL FLOW RATE AT A (CU FT/SEC).
C      A - TRIAL RADIUS (FT).
C      RF - RADIUS OF PIPE (FT).
C      Q(I) - INCREMENTAL FLOW RATES (CU FT/SEC).
C      RA(I) - OLD VALUES OF RADII (FT).
C      R(I) - NEWLY CALCULATED RADII (FT).
C      N - NUMBER OF INCREMENTS.
C      NP - NUMBER OF STREAMLINES.
C      WALL).
C      RI(I) - RADIAL POSITION OF STREAMLINES (MEASURED FROM
C      VI(I) - VELOCITY OF STREAMLINES (FT/SEC).
C      LIST OF SYMBOLS
C      INTERVAL ITERATION AND REGUL-FALS1 ITERATION.
C      RATES AGREE WITH PREVIOUSLY DEFINED VALUES USING GOLDEN
C      RADII, SHIFTS STREAMLINE RADII SO THAT THE INCREMENTAL FLOW
C      RADII, IS CALLED BY 'OPTIM'.
C      SUBROUTINE RADII (VI, RI, NP, RF, A, EPS)

```

```

      QA=ABS(FQ-Q(I))/Q(I)
C      CHECK TO SEE IF THERE HAS BEEN A CHANGE IN FLOW RATE
C      ERROR, I.E. IF EPS IS SMALLER THAN CAN BE TOLERATED.
      IF (ABS(QA-QB).GT.1.0E-30) GO TO 8
      WRITE(6,7) QA, EPS
7     FORMAT(1H ,14X,5HQA = ,E15.8,13HWHILE EPS3 = ,E15.8)
      QA=1.0E-30
C      IF FLOW RATE ERROR IS TOO LARGE OBTAIN NEW TRIAL VALUE
C      FROM 'GOLDIT'.
8     IF (QA.GT.EPS) GO TO 9
C      STORE NEW RADIUS IN VECTOR R( ).
15    R(I1)=A
C      REGULI FALSI SEARCH FOR THE REMAINING RADII.
      N1=N-1
      DO 12 I=2,N1
C      INITIALIZE FOR INITIAL TRIAL VALUE.
      I1=I+1
      O=R(I)
      A=RA(I1)
      GO TO 14
C      NEW TRIAL VALUE FROM REGULI-FALSI CALCULATION.
11    CONTINUE
      A=A-QA*(A-O)/(QA-QO)
C      CALCULATE INCREMENTAL FLOW RATE FROM A TO O.
14    CALL INTCON (V1, RA, NP, FQ, A, O)
C      CALCULATE ERROR IN FLOW RATE.
      QA=(FQ-Q(I))/Q(I)
C      IF QA LESS THAN EPS STORE A AND DO NEXT VALUE.
      IF (ABS(QA).GT.EPS) GO TO 11
12    R(I1)=A
C      REDEFINE RADIAL POSITION VECTOR.
      DO 13 I=2,N
13    R1(I)=RF-R(I)
      RETURN
      END

```



```

      QA=ABS(FQ-Q(I))\Q(I)
      CHECK TO SEE IF THERE HAS BEEN A CHANGE IN FLOW RATE
      ERROR, I.E. IF EPS IS SMALLER THAN CAN BE TOLERATED.
      IF (ABS(QA-QB).GT.1.0E-30) GO TO 8
      WRITE(6,7) QA, EPS
      7 FORMAT(1H, 14X, 2HQA = ,E12.8, 13HWHILE EPS = ,E12.8)
      QA=1.0E-30
      IF FLOW RATE ERROR IS TOO LARGE OBTAIN NEW TRIAL VALUE
      FROM 'GOLDI'.
      8 IF (QA.GT.EPS) GO TO 9
      STORE NEW RADIUS IN VECTOR R1.
      12 R(11)=A
      REGULI FALS SEARCH FOR THE REMAINING RADII.
      NI=N-1
      DO 13 I=2,NI
      INITIALIZE FOR INITIAL TRIAL VALUE.
      11 I=1+I
      O=R(11)
      A=RA(11)
      GO TO 14
      NEW TRIAL VALUE FROM REGULI-FALS CALCULATION.
      11 CONTINUE
      A=A-QA*(A-O)\(QA-O)
      CALCULATE INCREMENTAL FLOW RATE FROM A TO O.
      14 CALL INTCON (VI, RA, NP, FQ, A, O)
      CALCULATE ERROR IN FLOW RATE.
      QA=(FQ-Q(I))\Q(I)
      IF QA LESS THAN EPS STORE A AND DO NEXT VALUE.
      IF (ABS(QA).GT.EPS) GO TO 11
      12 R(11)=A
      REDFINE RADIAL POSITION VECTOR.
      13 R(11)=R(11)+R(11)
      DO 13 I=2,N
      RETURN
      END

```

SUBROUTINE SINT (JT, JS, GT, GTOW, GDVDR, T, TW, KA, R1, I,  
1 VEL, RF)

'SINT' IS CALLED BY 'INITPR' AND BY 'SUBINT'.  
'SINT' CALCULATES THE INCREASE IN VELOCITY ACROSS AN INCRE-  
MENT BY INTEGRATING SHEAR RATE ACCORDING TO GAUSSIAN THREE-  
POINT QUADRATURE. THE INCREASE IN VELOCITY IS USED IN CON-  
STRUCTION OF THE VELOCITY PROFILE.

#### LIST OF SYMBOLS

GTOW( ) - SHEAR STRESS DATA.  
GT( , ) - TIME DATA.  
GDVDR( , ) - SHEAR RATE DATA.  
JT( ) - EXTENT OF TIME AND SHEAR RATE POINTS.  
JS - EXTENT OF JT (AT EACH SHEAR STRESS) AND OF  
SHEAR STRESS POINTS.  
I - INTEGER STREAMLINE NUMBER (NUMBERED FROM PIPE  
WALL).  
R1( ) - RADIAL POSITION OF STREAMLINE (MEASURED FROM  
WALL).  
BB - OUTER EDGE OF INCREMENT (FROM WALL).  
AA - INNER EDGE OF INCREMENT (FROM WALL).  
RF - RADIUS OF PIPE (FT).  
M - QUADRATURE POINT NUMBER (1 TO 3).  
Z - QUADRATURE POINT LOCATION (-1 TO +1) CORRES-  
PONDING TO VALUE OF M.  
H - INTEGRAL WEIGHTING FACTOR CORRESPONDING TO M.  
F - RADIAL POSITION CORRESPONDING TO Z  
TOWR - SHEAR STRESS AT F.  
T( ) - STORED AGES AT QUADRATURE LOCATION IN THE PIPE.  
TR - FLUID AGE AT F  
YF - SHEAR RATE AT F.  
SG - INTEGRAL ON RANGE -1 TO +1 (1/SEC).  
VEL - INTEGRAL ACROSS INCREMENT (FT/SEC), OR  
INCREASE IN VELOCITY ACROSS INCREMENT.

REAL R1(35), GTOW(30), GT(30,30), GDVDR(30,30), SG, Z, H,  
1 F, TOWR, VEL, BB, AA, RF, YF, TR, TW, T(100)

INTEGER M, I, KA, JS, JT(30), II

SPECIFY INCREMENT BOUNDS AND INITIALIZE INTEGRATION.

SG=0.00

BB=R1(I)

AA=R1(I-1)

M=1

SELECT Z AND H CORRESPONDING TO M.

130 GO TO (131,132,133),M

131 Z=-0.77459667

H=0.55555555

GO TO 134

132 Z=0.00

H=0.88888888

GO TO 134

133 Z=+0.77459667



SUBROUTINE SINT (J1, J2, GT, GROW, GROWR, T, TW, KA, KI, I,

VEL, RF)

SINT IS CALLED BY INITPR, AND BY SUBINT.

SINT CALCULATES THE INCREASE IN VELOCITY ACROSS AN INCRE-  
MENT BY INTEGRATING SHEAR RATE ACCORDING TO GAUSSIAN THREE-  
POINT QUADRATURE. THE INCREASE IN VELOCITY IS USED IN CON-  
STRUCTION OF THE VELOCITY PROFILE.

# LIST OF SYMBOLS

GROW ( ) - SHEAR STRESS DATA.

GT ( ) - TIME DATA.

GROWR ( ) - SHEAR RATE DATA.

J1 ( ) - EXTENT OF TIME AND SHEAR RATE POINTS.

J2 - EXTENT OF JT (AT EACH SHEAR STRESS) AND OF

SHEAR STRESS POINTS.

I - INTEGER STREAMLINE NUMBER (NUMBERED FROM PIPE

WALL).

R1 ( ) - RADIAL POSITION OF STREAMLINE (MEASURED FROM

WALL).

BB - OUTER EDGE OF INCREMENT (FROM WALL).

AA - INNER EDGE OF INCREMENT (FROM WALL).

RF - RADIUS OF PIPE (FT).

M - QUADRATURE POINT NUMBER (1 TO 3).

Z - QUADRATURE POINT LOCATION (-1 TO +1) CORRES-

PONDING TO VALUE OF M.

H - INTEGRAL WEIGHTING FACTOR CORRESPONDING TO M.

F - RADIAL POSITION CORRESPONDING TO Z

TOWR - SHEAR STRESS AT F.

T ( ) - STORED AGES AT QUADRATURE LOCATION IN THE PIPE.

TR - FLUID AGE AT F.

YF - SHEAR RATE AT F.

SC - INTEGRAL ON RANGE -1 TO +1 (1/SEC).

VEL - INTEGRAL ACROSS INCREMENT (1/SEC), OR

INCREASE IN VELOCITY ACROSS INCREMENT.

REAL R1(3), GROW(3), GT(3,3), GROWR(3,3), SC, Z, H,

I F, TOWR, VEL, BB, AA, RF, TR, TW, T(100)

INTEGER M, I, KA, J2, JT(30), II

SPECIFY INCREMENT BOUNDS AND INITIALIZE INTEGRATION.

SG=0.00

BB=R1(1)

AA=R1(-1)

M=1

SELECT Z AND H CORRESPONDING TO M.

GO TO (131,132,133),M

Z=-0.77459667

H=0.5555555

GO TO 134

Z=0.00

H=0.8888888

GO TO 134

Z=+0.77459667

H=0.55555555

C CONVERT Z TO RADIAL POSITION F.

134 F=((BB-AA)\*Z+AA+BB)/2.

C CALCULATE SHEAR STRESS AT F.

TOWR=(RF-F)\*TW/RF

C DEFINE TIME AT F FROM STORED AGE.

II=3\*I-6+M

TR=T(II)

C CLACULATE SHEAR RATE.

CALL INTERB (JT, JS, GT, GTOW, GDVDR, TR, TOWR\*1000., YF,  
1 KA)

C IF SHEAR STRESS DATA IS EXCEEDED RETURN.

IF (KA.EQ.1) RETURN

C ADD INTEGRAL AT F.

SG=SG+H\*YF

C INCREASE M AND CHECK FOR COMPLETION OF INTEGRATION.

M=M+1

IF (M.LE.3) GO TO 130

C CONVERT INTEGRAL TO INCREASE IN VELOCITY.

VEL=(BB-AA)\*SG/2.

RETURN

END



```

END
RETURN
VEL=(BB-AA)*SG\2.
CONVERT INTEGRAL TO INCREASE IN VELOCITY.
IF (M.LE.3) GO TO 130
M=M+1
INCREASE M AND CHECK FOR COMPLETION OF INTEGRATION.
SG=SG+H*YF
ADD INTEGRAL AT F.
IF (KA.EQ.1) RETURN
IF SHEAR STRESS DATA IS EXCEEDED RETURN.
I KA)
CALL INTERB (JT, JS, GT, GTOW, GVDOR, TR, TOWR*1000., YF,
          CLACULATE SHEAR RATE.
          TR=1/I)
I1=3*I-6+M
DEFINE TIME AT F FROM STORED AGE.
TOWR=(TR-F)*TW\RF
CALCULATE SHEAR STRESS AT F.
F=((BB-AA)*Z+AA+BB)\2.
CONVERT Z TO RADIAL POSITION F.
M=0.25252525

```

```

SUBROUTINE SUBINT (JT, JS, GT, GTOW, GDVDR, T, TW, N, RF,
1 R1, V1, QG, QE, Q2, VZ)
C 'SUBINT' IS CALLED BY 'OPTIM'.
C 'SUBINT' CALCULATES THE VELOCITY PROFILE AND INCREMENTAL FLOW
C RATES FROM GIVEN RADIAL POSITIONS, STREAMLINE AGES, AND WALL
C SHEAR STRESS. THE ERROR IN TOTAL FLOW RATE IS CALCULATED.
C
C LIST OF SYMBOLS
C GTOW( ) - SHEAR STRESS DATA.
C GT( , ) - TIME DATA.
C GDVDR( , ) - SHEAR RATE DATA.
C JT( ) - EXTENT OF TIME AND SHEAR RATE POINTS.
C JS - EXTENT OF JT (AT EACH SHEAR STRESS) AND OF
C SHEAR STRESS.
C RF - RADIUS OF PIPE (FT).
C R1( ) - RADIAL POSITIONS OF STREAMLINES (FROM PIPE
C WALL) (FT).
C RA( ) - RADII OF STREAMLINES (FT).
C T( ) - FLUID AGES AT QUADRATURE LOCATIONS (MIN).
C NP - NUMBER OF STREAMLINES.
C N - NUMBER OF INCREMENTS.
C I - INTEGER NUMBER OF INCREMENT BOUNDED BY STREAM-
C LINES I AND I+1 (NUMBERED FROM THE WALL).
C V1( ) - VELOCITY POINTS (FT/SEC).
C VEL - INCREMENTAL INCREASE IN VELOCITY (FT/SEC).
C Q2( ) - INCREMENTAL FLOW RATES (CU FT/SEC).
C QSUM - CALCULATED TOTAL FLOW RATE (CU FT/SEC).
C QG - GIVEN TOTAL FLOW RATE.
C QE - ERROR ASSOCIATED WITH QSUM.
REAL TW, R1(35), RA(35), T(100), RF, QSUM, FQ, QE, VEL, QG,
1 V1(35), Q2(35), GTOW(30), GT(30,30), GDVDR(30,30), VZ(100)
INTEGER I, N, NP, JS, JT(30), KA
NP=N+1
C DEFINE RADII FROM RADIAL POSITIONS.
DO 21 I=1,NP
21 RA(I)=RF-R1(I)
C CALCULATE VELOCITY PROFILE.
V1(1)=0.00
DO 22 I=2,NP
CALL SINT (JT, JS, GT, GTOW, GDVDR, T, TW, KA, R1, I, VEL,
1 RF)
C INCREMENTAL INCREASE IN VELOCITY IS ADDED TO VELOCITY AT
C FRONT OF INCREMENT.
22 V1(I)=V1(I-1)+VEL
C CALCULATE INCREMENTAL FLOW RATES.
QSUM=0.00
DO 23 I=1,N
CALL INTEGR (V1, RA, I, NP, FQ, VZ)
C STORE INCREMENTAL FLOW RATE.
Q2(I)=FQ
C SUM FOR TOTAL CALCULATED FLOW RATE.

```



```

C      SUM FOR TOTAL CALCULATED FLOW RATE.
C      Q2(I)=FQ
C      STORE INCREMENTAL FLOW RATE.
C      CALL INTEGR (VI, RA, I, NP, FQ, V2)
DO 23 I=1,N
      QSUM=0.00
C      CALCULATE INCREMENTAL FLOW RATES.
C      V1(I)=V1(I-1)+VEL
C      FRONT OF INCREMENT.
C      INCREMENTAL INCREASE IN VELOCITY IS ADDED TO VELOCITY AT
      I (RF)
      CALL SINT (JT, J2, GT, GTOW, GVDOR, T, TW, KA, RI, I, VEL,
DO 22 I=2,NP
      V1(I)=0.00
C      CALCULATE VELOCITY PROFILE.
C      RAIL(RF-RI(I))
DO 21 I=1,NP
      DO 21 I=1,NP
      DEFINE RAIL FROM RADIAL POSITIONS.
      NP=N+1
      INTEGER I, N, NP, J2, JT(30), KA
      I V1(32), Q2(32), GTOW(30), GT(30,30), GVDOR(30,30), V2(100)
      REAL TW, RI(32), RAI(32), T1(00), RF, QSUM, FQ, Q2, VEL, Q2,
      Q2 - ERROR ASSOCIATED WITH QSUM.
      Q2 - GIVEN TOTAL FLOW RATE.
      QSUM - CALCULATED TOTAL FLOW RATE (CU FT/SEC).
      Q2(I) - INCREMENTAL FLOW RATES (CU FT/SEC).
      VEL - INCREMENTAL INCREASE IN VELOCITY (FT/SEC).
      V1(I) - VELOCITY POINTS (FT/SEC).
      LINES I AND I+1 (NUMBERED FROM THE WALL).
      I - INTEGER NUMBER OF INCREMENT BOUNDED BY STREAM-
      N - NUMBER OF INCREMENTS.
      NP - NUMBER OF STREAMLINES.
      T(I) - FLUID AGES AT QUADRATURE LOCATIONS (MIN).
      RAI(I) - RADIUS OF STREAMLINES (FT).
      RIL(I) - RADIAL POSITIONS OF STREAMLINES (FROM PIPE
      RF - RADIUS OF PIPE (FT).
      SHEAR STRESS.
      J2 - EXTENT OF JT (AT EACH SHEAR STRESS) AND OF
      JT(I) - EXTENT OF TIME AND SHEAR RATE POINTS.
      GVDOR(I) - SHEAR RATE DATA.
      GT(I) - TIME DATA.
      GTOW(I) - SHEAR STRESS DATA.
C      LIST OF SYMBOLS
C      SHEAR STRESS.
C      J2 - EXTENT OF JT (AT EACH SHEAR STRESS) AND OF
C      JT(I) - EXTENT OF TIME AND SHEAR RATE POINTS.
C      GVDOR(I) - SHEAR RATE DATA.
C      GT(I) - TIME DATA.
C      GTOW(I) - SHEAR STRESS DATA.
C      LIST OF SYMBOLS
C      SUBROUTINE SUBINT (JT, J2, GT, GTOW, GVDOR, T, TW, N, RF,
      I RI, VI, Q2, Q2, V2)
      SUBINT IS CALLED BY OPTIM.
      SUBINT CALCULATES THE VELOCITY PROFILE AND INCREMENTAL FLOW
      RATES FROM GIVEN RADIAL POSITIONS, STREAMLINE AGES, AND WALL
      SHEAR STRESS. THE ERROR IN TOTAL FLOW RATE IS CALCULATED.
      SUBROUTINE SUBINT (JT, J2, GT, GTOW, GVDOR, T, TW, N, RF,

```



C

53

Q2UM=Q2UM+FO

FIND ERROR IN FLOW RATE.

QE=(Q2-Q2UM)/Q2

RETURN

END



SUBROUTINE TIME (TINIT, JS, JT, GTOW, GT, GDVDR, DELTAL,  
1 QG, N, NMAX, TOWMIN, RF, EPS1, EPS2, EPS3, EPS4, EPS5,  
2 EPS6, REN, JW1, JW2, TT, NT, EPS7, XL, RR)

'TIME' IS CALLED BY THE CONTROL PROGRAM.

'TIME' CALCULATES ACCUMULATED PRESSURE DROP, LONGITUDINAL  
SHEAR STRESS PROFILES FOR SUB-LIMITING DURATION OF FLOW  
CONDITIONS, AND ALL PROFILES IN WHICH A PLUG CONDITION  
IS PRESENT.

#### LIST OF SYMBOLS

J - INTEGER LOCATING POSITION ALONG PIPE.  
TOW( ) - VECTOR OF WALL SHEAR STRESSES ALONG  
PIPE (LB/SQ FT).  
PL( ) - DISTANCE FROM THE PIPE ENTRANCE OF TOW(J) (FT).  
XL - LENGTH OF PIPE (FT).  
NJ - UPPER LIMIT OF J.  
TT( ) - VALUES OF FLOW DURATIONS TO RECALCULATE (MIN).  
NT - NUMBER OF THESE VALUES.  
IT - SUBSCRIPT ON TT( ).  
TAGE - VALUE OF TT(IT).  
JJT( ) - INTEGER POSITION OF PROFILE AT WHICH THESE  
CALCULATIONS BEGIN.  
N - NUMBER OF INCREMENTS.  
NP - NUMBER OF STREAMLINES.  
NN - NUMBER OF QUADRATURE LOCATIONS IN X-SECTION.  
TJ( , ) - DEFINES PREVIOUS PROFILE AGES AT QUADRATURE  
POINTS FOR INITIALIZATION OF CALCULATION.  
VJ( , ) - DEFINES PREVIOUS PROFILE VELOCITIES AT  
QUADRATURE POINTS FOR INITIALIZATION.  
RJ( , ) - PREVIOUS PROFILE STREAMLINE POSITIONS  
FOR INITIALIZATION.  
TP( ) - PREVIOUS PROFILE AGES.  
VP( ) - PREVIOUS PROFILE VELOCITIES.  
R1( ) - STREAMLINE RADIAL POSITIONS.  
T( ) - PRESENT PROFILE AGES.  
VZ( ) - PRESENT PROFILE VELOCITIES.  
KOT,KOJ - INTEGER SPECIFYING GEL CONDITION,  
EQUALS 0 - NO GEL, EQUALS 1 - RADIUS OF GEL  
IS SPECIFIED, EQUALS 2 - RADIUS OF GEL MUST  
BE FOUND.  
PP( ) - POSITION ALONG PIPE (FT).  
DP( ) - TOTAL PRESSURE DROP (LB/SQ IN) UP TO PP( ).  
JR( ) - NUMBER OF POINTS IN PP( ) VECTOR.  
TW - SHEAR STRESS.  
TSAVE - LIMITING VALUE OF SHEAR STRESS AT PIPE EXIT.

REAL TAGE, TW, TSAVE, T(100), TOW(50), PL(50), TINIT,  
1 GTOW(30), GT(30,30), GDVDR(30,30), Q(35), R1(35), V1(35),  
2 RR, RF, TOWMIN, QG, EPS1, EPS2, EPS3, EPS4, EPS5, EPS6,  
3 EPS7, REN, DP(100), PP(100), TP(100), TT(10), VP(100), W  
4, DELTAL, XL, TWO, VZ(100), TJ(100,10), RJ(35,10), VJ(100,  
5 10), PSUM, Q2(35)



```

2 IOI, P2UM, Q2I32)
I GTOW(30), GTI30,30), G2VON(30,30), QI32), RI(32), WI(32),
2 PR, RT, TOWMIN, Q0, EP21, EP22, EP23, EP24, EP25, EP26,
3 EP27, REN, DP(100), PP(100), TP(100), TT(10), VP(100),
4 DELTA, XL, TWO, V2(100), TJ(100,10), RJ(32,10), V2(100,
TSAVE - LIMITING VALUE OF SHEAR STRESS AT PIPE EXIT.
TW - SHEAR STRESS.
JR( ) - NUMBER OF POINTS IN PP( ) VECTOR.
CP( ) - TOTAL PRESSURE DROP (LB/2G IN) UP TO PP( ).
PP( ) - POSITION ALONG PIPE (FT).
BE FOUND.
IS SPECIFIED, EQUALS 2 - RADIUS OF GEL MUST
EQUALS 0 - NO GEL, EQUALS 1 - RADIUS OF GEL
KUT,KOJ - INTEGER SPECIFYING GEL CONDITION,
V2( ) - PRESENT PROFILE VELOCITIES.
T( ) - PRESENT PROFILE AGES.
RI( ) - STREAMLINE RADIAL POSITIONS.
VP( ) - PREVIOUS PROFILE VELOCITIES.
TP( ) - PREVIOUS PROFILE AGES.
FOR INITIALIZATION.
RJ( ) - PREVIOUS PROFILE STREAMLINE POSITIONS
QUADRATURE POINTS FOR INITIALIZATION.
VJ( ) - DEFINES PREVIOUS PROFILE VELOCITIES AT
POINTS FOR INITIALIZATION OF CALCULATION.
TJI( ) - DEFINES PREVIOUS PROFILE AGES AT QUADRATURE
NN - NUMBER OF QUADRATURE LOCATIONS IN X-SECTION.
NP - NUMBER OF STREAMLINES.
N - NUMBER OF INCREMENTS.
CALCULATIONS BEGIN.
JTI( ) - INTEGER POSITION OF PROFILE AT WHICH THESE
TAGE - VALUE OF TTI( ).
IT - SUBSCRIPT ON TTI( ).
NT - NUMBER OF THESE VALUES.
TTI( ) - VALUES OF FLOW DURATIONS TO RECALCULATE (MIN).
NJ - UPPER LIMIT OF J.
XL - LENGTH OF PIPE (FT).
PL( ) - DISTANCE FROM THE PIPE ENTRANCE OF TOW(J) (FT).
TOW( ) - VECTOR OF WALL SHEAR STRESSES ALONG
J - INTEGER LOCATING POSITION ALONG PIPE.
LIST OF SYMBOLS
IS PRESENT.
CONDITIONS, AND ALL PROFILES IN WHICH A PLUS CONDITION
SHEAR STRESS PROFILES FOR SUB-LIMITING DURATION OF FLOW
TIME, CALCULATES ACCUMULATED PRESSURE DROP, LONGITUDINAL
TIME, IS CALLED BY THE CONTROL PROGRAM.
2 EP26, REN, JWI, JWS, TT, NT, EP27, XL, RP)
I Q0, N, NMAX, TOWMIN, RP, EP21, EP22, EP23, EP24, EP25,
SUBROUTINE TIME (TIMT, JS, JT, GTOW, GT, G2VON, DELTA,

```



```

      INTEGER KOT, KA, N, J, I, NP, JS, JT(30), NMAX, NJ1, NJ,
1 JJ, NT, JW1, JW2, IT, KOJ, N1, N2, JJT(10), JZ, KR, NZ, JR
C      DEFINE NON-GEL CONDITION.
      KOJ=0
      TWO=0.00
C      IF THERE IS NO GEL, GO TO 800.
      IF (TOWMIN.LE.1.0E-30) GO TO 800
C      DEFINE GEL CONDITION AT FLUID AGE OF ZERO.
      KOJ=1
      T(1)=0.00
C      IF PLUG RADIUS IS PREVIOUSLY DEFINED, GO TO 800.
      IF (RR.GT.1.0E-30) GO TO 800
C      CALCULATE PLUG RADIUS AND WALL SHEAR STRESS.
      KOT=2
      CALL INITPR (V1, R1, T, TW, RR, RF, N, JT, JS, GT, GTOW,
1 GDVDR, KOT, Q, TOWMIN, KA, QG, EPS1, EPS2, NMAX, VZ)
      IF (KA.EQ.1) RETURN
      TWO=TW
C      PRINT OUT PROFILE.
      IF (JW1.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RR)
C      THE AGE OF FLOW IS THE FINAL PROGRAMMED DURATION.
800 TAGE=TT(NT)
C      CALCULATE SHEAR STRESSES AND SELECT CALCULATIONAL
C      POINTS ALONG PIPE.
      CALL LENGTH (TAGE, TINIT, JT, JS, GT, GTOW, GDVDR, TOWMIN,
1 EPS1, EPS2, EPS3, EPS4, EPS5, EPS6, DELTAL, QG, N, RF, NJ,
2 TOW, PL, JW1, EPS7, Q, XL, TJ, RJ, VJ, TT, NT, N2, JJT,
3 REN, NMAX)
      NZ=3*N
      N1=N2-1
      NP=N+1
C      IF A GEL EXISTS, THE CONSTANT AGE PROFILES NEAR EXIT
C      MUST BE RECALCULATED.
      IF (KOJ.LT.1) GO TO 825
      KOT=1
      T(1)=TAGE
      CALL INITPR (V1, R1, T, TW, RR, RF, N, JT, JS, GT, GTOW,
1 GDVDR, KOT, Q2, TOWMIN, KA, QG, EPS1, EPS2, NMAX, VZ)
      IF (JW1.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q2, T, REN, KOT, RR)
C      THE SHEAR STRESS IS THEN ASSIGNED.
      NJ1=NJ
      IF (JJT(NT).GT.0) NJ1=JJT(NT)
      DO 820 J=NJ1, NJ
820 TOW(J)=TW
825 IT=0
C      CALCULATE ACCUMULATIVE PRESSURE DROP USING
C      SIMPSON'S RULE.
804 PP(1)=0.00
      DP(1)=0.00
      JR=NJ/2

```



```

      JR=175
      DP(1)=0.00
      PR(1)=0.00
      C
      SIMPSON'S RULE
      C
      CALCULATE ACCUMULATIVE PRESSURE DROP USING
      825
      IT=0
      920
      TOW(1)=TW
      DO 820 J=1,N1
      IF (J1TINT).GT.0) N1=J1TINT
      N1=N1
      C
      THE SHEAR STRESS IS THEN ASSIGNED.
      I QS, T, REN, KOT, RR)
      IF (JW1.GT.0) CALL WRITE1 (IAGE, RF, TW, J, PL, N, RI, VI,
      I GDOR, KOT, QS, TOWMIN, KA, GC, EP21, EP22, NMAX, V2)
      CALL INITPR (VI, RI, T, TW, RR, RF, N, JT, J2, GT, GTOW,
      I GDOR, KOT, QS, TOWMIN, KA, GC, EP21, EP22, NMAX, V2)
      2 TOW, PL, JW1, EP27, Q, XL, TJ, RJ, VJ, TT, NT, NS, JLT,
      I EP21, EP22, EP23, EP24, EP25, EP26, DELTA, GC, N, RF, N1,
      CALL LENGTH (IAGE, TINT, JT, J2, GT, GTOW, GDOR, TOWMIN,
      POINTS ALONG PIPE.
      C
      CALCULATE SHEAR STRESSES AND SELECT CALCULATIONAL
      800
      TAGE=TINT)
      C
      THE AGE OF FLOW IS THE FINAL PROGRAMMED DURATION.
      I Q, T, REN, KOT, RR)
      IF (JW1.GT.0) CALL WRITE1 (IAGE, RF, TW, J, PL, N, RI, VI,
      PRINT OUT PROFILE.
      TWO=TW
      IF (KA.EQ.1) RETURN
      I GDOR, KOT, QS, TOWMIN, KA, GC, EP21, EP22, NMAX, V2)
      CALL INITPR (VI, RI, T, TW, RR, RF, N, JT, J2, GT, GTOW,
      KOT=2
      C
      CALCULATE PLUG RADIUS AND WALL SHEAR STRESS.
      IF (RR.GT.1.0E-30) GO TO 800
      IF PLUG RADIUS IS PREVIOUSLY DEFINED, GO TO 800.
      T(1)=0.00
      KQ=1
      C
      DEFINE GEL CONDITION AT FLUID AGE OF ZERO.
      IF (TOWMIN.LE.1.0E-30) GO TO 800
      IF THERE IS NO GEL, GO TO 800.
      TWO=0.00
      KQ=0
      C
      DEFINE NON-GEL CONDITION.
      I JJ, NT, JW1, JWS, IT, KQJ, NI, NS, J1T(10), J2, KR, NS, JR
      INTEGER KOT, KA, N, J, I, NP, J2, J1(30), NMAX, N1, N1,

```

```

DO 805 J=2, JR
  JJ=2*J-1
  DP(J)=(PL(JJ)-PL(JJ-1))*(TOW(JJ)+4.*TOW(JJ-1)+TOW(JJ-2))/3.
1 *2./((144.*RF)+DP(J-1))
805 PP(J)=PL(JJ)
  JR=JR+1
  PP(JR)=XL
  PSUM=0.00
  DO 806 J=JJ, NJ
806 PSUM=PSUM+TOW(J)
  W=NJ-JJ+1
  DP(JR)=PSUM/W*2./((144.*RF)*(PL(NJ)-PL(JJ))+DP(JR-1))
C      PRINT OUT PRESSURE DROP VERSUS LENGTH.
  IF (JW2.GT.0) CALL WRITE2( TAGE, PP, DP, JR )
C      IF ALL FLOW DURATIONS HAVE BEEN CALCULATED, RETURN
C      TO CONTROL PROGRAM.
  IF (IT.GE.N1) RETURN
C      SELECT A NEW FLOW DURATION.
  IT=IT+1
  TAGE=TT(IT)
C      IF FLOW AGE IS ZERO, GO TO 813.
  IF (TAGE.LE.1.0E-30) GO TO 813
C      FIND POINT IN PIPE WHERE CALCULATION BEGINS.
  JZ=JJT(IT)
  TW=TOW(JZ)
C      ASSIGN AGE, VELOCITY, AND RADIUS PROFILES AT PREVIOUS
C      LONGITUDINAL POINT.
  DO 814 I=1, NZ
    TP(I)=TJ(I, IT)
814 VP(I)=VJ(I, IT)
  DO 821 I=1, NP
821 R1(I)=RJ(I, IT)
  KR=0
C      CALCULATE UNTIL EITHER THE END OF THE PIPE, OR
C      COMPLETE AGING IS ACHIEVED.
  DO 810 J=JZ, NJ
    JJ=J
    CALL OPTIM (TAGE, TINIT, JT, JS, GT, GTOW, GDVDR, EPS3,
1 EPS4, EPS5, QG, Q, RF, R1, VP, TW, PL, J, T, TP, KR, N,
2 V1, EPS6, VZ)
C      PRINT OUT PROFILE.
  IF (JW1.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q, T, REN, KOT, RR)
C      STORE AGES AND VELOCITIES FOR NEXT PROFILE CALCULATION.
  DO 815 I=1, NZ
    VP(I)=VZ(I)
815 TP(I)=T(I)
C      IF AGE IS CONSTANT ACROSS PIPE X-SECTION, GO TO 818.
  IF (KR.GT.0) GO TO 818
C      STORE SHEAR STRESS.
810 TOW(J)=TW
C      IF PLUG EXISTS, CALCULATE AND PRINT OUT PROFILE.

```



```

C      IF PLUG EXISTS, CALCULATE AND PRINT OUT PROFILE.
810  TOW(1)=TW
C      STORE AGES AND VELOCITIES FOR NEXT PROFILE CALCULATION.
I  Q, T, REN, KOT, RR
IF (JMI.GT.0) CALL WRITEL (TAGE, RP, TW, PL, J, T, TP, KR, W,
1  EPSA, EPS2, QG, R, RF, RI, VP, TW, PL, J, T, TP, KR, W,
2  VI, EPS2, V2)
C      PRINT OUT PROFILE.
CALL OPTIM (TAGE, TINIT, JT, JS, GT, GTOW, COVDR, EPS3,
3  J1=J
DO 810 J=J2,N1
C      COMPLETE AGING IS ACHIEVED.
C      CALCULATE UNTIL EITHER THE END OF THE PIPE, OR
KR=0
821  RI(1)=RJ(1,IT)
DO 821 I=1,NP
VP(1)=VJ(1,IT)
TP(1)=TJ(1,IT)
DO 814 I=1,N2
LONGITUDINAL POINT.
ASSIGN AGE, VELOCITY, AND RADIUS PROFILES AT PREVIOUS
TW=TOW(J2)
J2=J1(1T)
C      FIND POINT IN PIPE WHERE CALCULATION BEGINS.
IF (TAGE.LE.1.0E-30) GO TO 813
IF FLOW AGE IS ZERO, GO TO 813.
TAGE=T1(1T)
IT=IT+1
C      SELECT A NEW FLOW DURATION.
IF (IT.GE.N1) RETURN
TO CONTROL PROGRAM.
IF ALL FLOW DURATIONS HAVE BEEN CALCULATED, RETURN
IF (JMS.GT.0) CALL WRITEL (TAGE, RP, DP, JR, J
PRINT OUT PRESSURE DROP VERSUS LENGTH.
DP(JR)=P2UM*W*5.2\144.*RF)*(PL(N1)-PL(J1))+DP(JR-1)
W=N1-J1+1
P2UM=P2UM+TOW(1)
DO 806 J=J1,N1
P2UM=0.00
PP(JR)=XL
JR=JR+1
PP(J)=PL(J1)
805  I *5.2\144.*RF)+DP(J-1)
DP(J)=(PL(J1)-PL(J1-1))*(TOW(J1)+4.*TOW(J1-1)+TOW(J1-2))\3.
J1=J+1-1
DO 805 J=5,JR

```

```

811 IF (KOJ.LT.1) GO TO 818
    T(1)=TAGE
    KOT=KOJ
    CALL INITPR (V1, R1, T, TW, RR, RF, N, JT, JS, GT, GTOW,
1 GDVDR, KOT, Q2, TOWMIN, KA, QG, EPS1, EPS2, NMAX, VZ)
    IF (JW1.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q2, T, REN, KOT, RR)
C    DEFINE SHEAR STRESS OF REMAINING PIPE X-SECTIONS.
818 TSAVE=TW
    DO 812 J=JJ,NJ
812 TOW(J)=TSAVE
    GO TO 804
C    AT ZERO AGE, ALL POINTS HAVE SAME PRESSURE DROP.
813 TW=TOW(1)
C    IF ENTERING AGE IS ZERO, GO TO 821 TO CALCULATE
C    SHEAR STRESS.
    IF (TINIT.GT.1.0E-07) GO TO 822
C    IF GEL EXISTS, CALCULATE SHEAR STRESS.
    IF (KOJ.LT.1) GO TO 819
    IF (TWO.LT.1.0E-30) GO TO 822
    TW=TWO
    GO TO 819
822 T(1)=0.00
    KOT=KOJ
    CALL INITPR (V1, R1, T, TW, RR, RF, N, JT, JS, GT, GTOW,
1 GDVDR, KOT, Q2, TOWMIN, KA, QG, EPS1, EPS2, NMAX, VZ)
    J=1
    IF (JW1.GT.0) CALL WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1,
1 Q2, T, REN, KOT, RR)
C    ASSIGN SHEAR STRESS TO ALL VECTOR POINTS.
819 DO 817 J=1,NJ
817 TOW(J)=TW
    GO TO 804
END

```



```

811 IF (KOL.LT.1) GO TO 818
      T(1)=TAGE
      KOT=KOL
      CALL INITPR (VI, RI, T, TW, RR, RF, N, JT, JS, GT, GTOW,
      I GOVDR, KOT, QS, TOWMIN, KA, GG, EPSI, EPSZ, NMAX, VS)
      IF (JWI.GT.0) CALL WRITEI (TAGE, RF, TW, J, PL, RI, VI,
      I QS, T, REN, KOT, RR)
      DEFINE SHEAR STRESS OF REMAINING PIPE X-SECTIONS.
      TSAVE=TW
      818 DO 812 J=1,NJ
      812 TOW(J)=TSAVE
      GO TO 804
      AT ZERO AGE, ALL POINTS HAVE SAME PRESSURE DROP.
      813 TW=TOW(1)
      IF ENTERING AGE IS ZERO, GO TO 821 TO CALCULATE
      SHEAR STRESS.
      IF (TINIT.GT.1.0E-07) GO TO 822
      IF CEL EXISTS, CALCULATE SHEAR STRESS.
      IF (KOL.LT.1) GO TO 819
      IF (TWO.LT.1.0E-30) GO TO 822
      TW=TWO
      GO TO 819
      822 T(1)=0.00
      KOT=KOL
      CALL INITPR (VI, RI, T, TW, RR, RF, N, JT, JS, GT, GTOW,
      I GOVDR, KOT, QS, TOWMIN, KA, GG, EPSI, EPSZ, NMAX, VS)
      J=1
      IF (JWI.GT.0) CALL WRITEI (TAGE, RF, TW, J, PL, RI, VI,
      I QS, T, REN, KOT, RR)
      ASSIGN SHEAR STRESS TO ALL VECTOR POINTS.
      819 DO 817 J=1,NJ
      817 TOW(J)=TW
      GO TO 804
      END

```

SUBROUTINE WRITE1 (TAGE, RF, TW, J, PL, N, R1, V1, Q, T,  
1 REC, KOT, RR)

C 'WRITE1' IS CALLED BY 'LENGTH' AND BY 'TIME'.

C 'WRITE1' PRINTS OUT THE PERTINENT INFORMATION AT EACH PIPE  
C LOCATION.

C LIST OF SYMBOLS

C J - INTEGER ASSOCIATED WITH POSITION IN PIPE.

C PL( ) - ITS DISTANCE FROM THE ENTRANCE, FT.

C TW - SHEAR STRESS, LB/SQ FT.

C DELP - PRESSURE DROP PER FOOT, LB/SQ IN/FT.

C RR - WIDTH OF NON PLUG SECTION IF PLUG EXISTS, FT.

C DE - RADIUS OF PLUG, FT.

C RF - RADIUS OF PIPE, FT.

C I - INTEGER SPECIFYING INCREMENT NUMBER, STARTING  
C FROM THE WALL.

C R1( ) - DISTANCE OF STREAMLINE FROM WALL, FT.

C R( ) - RADIUS OF STREAMLINE, FT.

C V1( ) - VELOCITY AT R( ), FT/SEC.

C Q( ) - INCREMENTAL FLOW RATE, CU FT/SEC.

C T( ) - AGE DISTRIBUTION8 STARTING FROM WALL, MIN.

C TAGE - DURATION OF FLOW, MIN.

C REC - CONSTANT FOR REYNOLDS NUMBER (SQ FT/LB).

C REN - REYNOLDS NUMBER.

REAL TAGE, RF, TW, PL(50), R1(35), R(35), V1(35), Q(35),  
1 T(100), REN, RR, DELP, DE, REC

INTEGER I, N, J, NP, KOT

C FORMAT STATEMENTS (STATEMENTS 20 TO 31).

20 FORMAT(1H2,14X,18HTHE AGE OF FLOW IS,F10.4,2X,4HMIN.)

21 FORMAT(1HK,14X,41HWITH A PLUG, THE INITIAL PRESSURE DROP IS,  
1 F10.7,3X,12HLB/SQ IN/FT.)

22 FORMAT(1HK,14X,38HWITH A PLUG, THE EXIT PRESSURE DROP IS,  
1 F10.7, 3X, 12HLB/SQ IN/FT.)

23 FORMAT(1HK,14X,33HTHE INCREMENT NUMBER IN LENGTH IS,I4,2H .)

24 FORMAT(1HK,14X,2HAT,F11.3,2X,19HFEET, THE PRESSURE ,  
1 11HGRADIENT IS,F10.7,13H LB/SQ IN/FT.)

25 FORMAT(1HK,15X,6HRADIAL,36X,6HRADIAL,6X,13HAGE AT CENTRE)

26 FORMAT(1H ,14X,9HINCREMENT,6X,6HRADIUS,6X,8HVELOCITY,4X,  
1 14HINCREMENT FLOW, 2X, 12HOF INCREMENT)

27 FORMAT(1HS,17X,3HNO.,10X,4H(FT),7X,8H(FT/SEC),6X,  
1 11H(CU FT/SEC),7X,5H(MIN))

28 FORMAT(1H ,28X,F8.5,4X,F8.5)

29 FORMAT(1H ,17X,12,35X,F10.7,5X,F13.4)

30 FORMAT(1HK,14X,18HTHE RENOLDS NO. IS,E15.8,2H .)

31 FORMAT(1HK,14X,19HTHE PLUG RADIUS IS ,F10.7,2X,5HFEET.)

C PRINTING PROCESS.

WRITE(6,20) TAGE

DELP=TW\*2./RF/144.

IF (KOT.LT.1) GO TO 10

DE=RF-RR

IF (KOT.LT.2) GO TO 11



IF (KOT.LT.2) GO TO 11

DE=RF-RR

IF (KOT.LT.1) GO TO 10

DELP=TW\*2.7\*RF/144.

WRITE(6,20) TAG

PRINTING PROCESS.

31 FORMAT(IK,1X,18THE PLUG RADIUS IS ,F10.7,2X,2SHEET.)

30 FORMAT(IK,1X,18THE REYNOLDS NO. IS ,E12.8,2X.)

29 FORMAT(IH,1X,12,35X,F10.7,2X,F13.4)

28 FORMAT(IH,1X,28X,F8.2,2X,F8.2)

1 I I H(CU FT/SEC),7X,2H(MIN)

27 FORMAT(IH,1X,3HNO.,10X,4H(FT),7X,8H(FT/SEC),6X,

1 I A H I N C R E M E N T F L O W , 2 X , 1 2 H O F I N C R E M E N T )

26 FORMAT(IH,1X,9H I N C R E M E N T , 6 X , 6 H R A D I U S , 6 X , 6 H V E L O C I T Y , 4 X ,

25 FORMAT(IK,1X,6H R A D I A L , 3 6 X , 6 H R A D I A L , 6 X , 1 3 H A T C E N T R E )

1 I I H G R A D I E N T I S , F 1 0 . 7 , 1 3 H L B \ 2 0 I N F T . )

24 FORMAT(IK,1X,3H A T , F 1 1 . 3 , 2 X , 1 9 H E E T , THE PRESSURE ,

23 FORMAT(IK,1X,3H THE INCREMENT NUMBER IN LENGTH IS , F 1 4 . 5 H . )

1 F 1 0 . 7 , 3 X , 1 2 H L B \ 2 0 I N F T . )

22 FORMAT(IK,1X,38H WITH A PLUG, THE EXIT PRESSURE DROP IS ,

1 F 1 0 . 7 , 3 X , 1 2 H L B \ 2 0 I N F T . )

21 FORMAT(IK,1X,41H WITH A PLUG, THE INITIAL PRESSURE DROP IS ,

20 FORMAT(IH,1X,18H THE AGE OF FLOW IS , F 1 0 . 4 , 2 X , 4 H M I N . )

FORMAT STATEMENTS (STATEMENTS 20 TO 31).

INTEGER I, N, J, NP, KOT

1-T(100), REN, RR, DELP, DE, REC

REAL TAG, RF, TW, PL(20), RI(32), R(32), VI(32), Q(32),

REN

- REYNOLDS NUMBER.

REC - CONSTANT FOR REYNOLDS NUMBER (20 FT/LB).

TAGE - DURATION OF FLOW, MIN.

TI - AGE DISTRIBUTION STARTING FROM WALL, MIN.

QI - INCREMENTAL FLOW RATE, CU FT/SEC.

VI - VELOCITY AT RI, FT/SEC.

RI - RADIUS OF STREAMLINE, FT.

RII - DISTANCE OF STREAMLINE FROM WALL, FT.

FROM THE WALL.

I - INTEGER SPECIFYING INCREMENT NUMBER, STARTING

RR - RADIUS OF PLUG, FT.

DE - RADIUS OF PLUG, FT.

RR - WIDTH OF NON PLUG SECTION IF PLUG EXISTS, FT.

DELP - PRESSURE DROP PER FOOT, LB/20 IN/FT.

TW - SHEAR STRESS, LB/20 FT.

PLI - ITS DISTANCE FROM THE ENTRANCE, FT.

J - INTEGER ASSOCIATED WITH POSITION IN PIPE.

LIST OF SYMBOLS

LOCATION.

WRITE, PRINTS OUT THE PERTINENT INFORMATION AT EACH PIPE  
WRITE, IS CALLED BY LENGTH, AND BY TIME.  
I REC, KOT, RR)

SUBROUTINE WRITE1 (TAG, RF, TW, J, PL, N, RI, VI, Q, T,  
I REC, KOT, RR)

```

WRITE(6,21) DELP
WRITE(6,31) DE
GO TO 12
11 WRITE(6,22) DELP
WRITE(6,31) DE
GO TO 12
10 WRITE(6,23) J
WRITE(6,24) PL(J), DELP
12 WRITE(6,25)
WRITE(6,26)
WRITE(6,27)
DO 13 I=1,N
R(I)=RF-R1(I)
I2=3*I-1
WRITE(6,28) R(I), V1(I)
13 WRITE(6,29) I, Q(I), T(I2)
NP=N+1
R(NP)=0.00
WRITE(6,28) R(NP), V1(NP)
C CALCULATE AND PRINT OUT REYNOLDS NUMBER.
REN=REC/TW
WRITE(6,30) REN
RETURN
END

```



```

END
RETURN
WRITE(6,30) REN
REN=RECTW
CALCULATE AND PRINT OUT REYNOLDS NUMBER.
WRITE(6,28) R(NP), V(NP)
R(NP)=0.00
NP=NP+1
13 WRITE(6,29) I, O(I), T(I)
WRITE(6,28) R(I), V(I)
IS=I-1
RI=RI-R(I)
DO I=1,N
WRITE(6,27)
WRITE(6,26)
WRITE(6,25)
WRITE(6,24) PL(I), DELP
10 WRITE(6,23) J
GO TO IS
WRITE(6,31) DE
11 WRITE(6,22) DELP
GO TO IS
WRITE(6,31) DE
WRITE(6,21) DELP

```



```

SUBROUTINE WRITE2 (TAGE, PP, DP, JJ)
C  'WRITE2' IS CALLED BY 'TIME'.
C  'WRITE2' PRINTS OUT THE ACCUMULATED PRESSURE DROP.
C
C  LIST OF SYMBOLS
C      TAGE      - DURATION OF FLOW, MIN.
C      PP( )     - DISTANCE FROM PIPE ENTRANCE, FT.
C      DP( )     - TOTAL PRESSURE DROP AFTER A DISTANCE OF PP( ).
C      J         - INTEGER SPECIFYING PP( ) AND DP( ) EXTENDING
C                  TO JJ.
C      REAL TAGE, PP(100), DP(100)
C      INTEGER J, JJ
C      FORMAT STATEMENTS (STATEMENTS 10 TO 14).
10  FORMAT(1H2,14X,18HTHE AGE OF FLOW IS,F10.4,2X,4HMIN.)
11  FORMAT(1HK,29X,22HDISTANCE FROM ENTRANCE,10X,8HPRESSURE)
12  FORMAT(1HS,35X,6H{FEET},19X,10H(LB/SQ IN))
13  FORMAT(1H ,34X,F11.3,14X,F11.5)
14  FORMAT(1HL,14X,4HWITH,F10.1,2X,25HFT., THE DROP IN PRESSURE,
1  3H IS,F10.4,2X,9HLB/SQ IN.)
C      PRINTING PROCESS.
      WRITE(6,10) TAGE
      WRITE(6,11)
      WRITE(6,12)
      WRITE(6,13) (PP(J), DP(J), J=1,JJ)
      WRITE(6,14) PP(JJ), DP(JJ)
      RETURN
      END

```



A P P E N D I X    4  
COMPUTER SAMPLE OUTPUT





THERE ARE 18 VALUES OF SHEAR STRESS.

FOR TOW( 1 ) = 0.0000 ,THERE ARE 2 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.0000	4000.0000	0.0000

FOR TOW( 2 ) = 10.0000 ,THERE ARE 12 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.0010	5.0000 0.2700	10.0000 0.3900
20.0000 0.5700	60.0000 0.9800	100.0000 1.2200
200.0000 1.5800	400.0000 1.9500	700.0000 3.5100
1000.0000 4.0600	1500.0000 3.9700	4000.0000 4.0000

FOR TOW( 3 ) = 20.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.0100	5.0000 1.8000	10.0000 2.4000
20.0000 3.3000	40.0000 4.4000	60.0000 5.0000
100.0000 5.8200	200.0000 7.1000	300.0000 7.9700
400.0000 8.5600	700.0000 19.1900	1000.0000 11.2200
1500.0000 13.4000	4000.0000 14.3000	

FOR TOW( 4 ) = 30.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.0300	5.0000 4.7500	10.0000 7.3000
20.0000 9.2500	40.0000 11.2500	60.0000 12.5000
100.0000 14.3500	200.0000 15.8000	300.0000 16.9000
400.0000 17.8000	700.0000 20.4500	1000.0000 23.2000
1500.0000 27.5000	4000.0000 29.2000	

FOR TOW( 5 ) = 40.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.1000	5.0000 10.6000	10.0000 15.5000
20.0000 13.7000	40.0000 21.9800	60.0000 23.6000
100.0000 25.7000	200.0000 28.5000	300.0000 30.6500
400.0000 32.2000	700.0000 35.8000	1000.0000 39.6000
1500.0000 45.6000	4000.0000 48.0000	

FOR TOW( 6 ) = 50.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.3500	5.0000 19.7000	10.0000 26.3000
20.0000 31.2000	40.0000 35.5000	60.0000 38.0000
100.0000 40.6000	200.0000 43.5000	300.0000 45.3000
400.0000 47.1000	700.0000 52.4000	1000.0000 57.8000
1500.0000 66.8000	4000.0000 70.0000	

FOR TOW( 7 ) = 60.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 0.9700	5.0000 31.5000	10.0000 40.8000
20.0000 47.3000	40.0000 52.5000	60.0000 55.7000
100.0000 59.2000	200.0000 63.9000	300.0000 66.2000



THERE ARE 18 VALUES OF SHEAR STRESS.

FOR TOW( 1 ) = 0.0000 , THERE ARE 5 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000

FOR TOW( 2 ) = 10.0000 , THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.0010	0.0010	0.0010	0.0010	0.0010
20.0000	0.0020	0.0020	0.0020	0.0020	0.0020
200.0000	0.0050	0.0050	0.0050	0.0050	0.0050
1000.0000	0.0100	0.0100	0.0100	0.0100	0.0100
4.0000	0.0200	0.0200	0.0200	0.0200	0.0200
1000.0000	0.0500	0.0500	0.0500	0.0500	0.0500
4.0000	0.1000	0.1000	0.1000	0.1000	0.1000
1000.0000	0.2000	0.2000	0.2000	0.2000	0.2000
4.0000	0.5000	0.5000	0.5000	0.5000	0.5000
1000.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.0000	2.0000	2.0000	2.0000	2.0000	2.0000
1000.0000	5.0000	5.0000	5.0000	5.0000	5.0000
4.0000	10.0000	10.0000	10.0000	10.0000	10.0000
1000.0000	20.0000	20.0000	20.0000	20.0000	20.0000
4.0000	50.0000	50.0000	50.0000	50.0000	50.0000
1000.0000	100.0000	100.0000	100.0000	100.0000	100.0000
4.0000	200.0000	200.0000	200.0000	200.0000	200.0000
1000.0000	500.0000	500.0000	500.0000	500.0000	500.0000
4.0000	1000.0000	1000.0000	1000.0000	1000.0000	1000.0000

FOR TOW( 3 ) = 20.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.0100	0.0100	0.0100	0.0100	0.0100
20.0000	0.0200	0.0200	0.0200	0.0200	0.0200
100.0000	0.0500	0.0500	0.0500	0.0500	0.0500
400.0000	0.1000	0.1000	0.1000	0.1000	0.1000
1500.0000	0.2000	0.2000	0.2000	0.2000	0.2000
13.4000	0.5000	0.5000	0.5000	0.5000	0.5000
4000.0000	1.0000	1.0000	1.0000	1.0000	1.0000
14.3000	2.0000	2.0000	2.0000	2.0000	2.0000
1000.0000	5.0000	5.0000	5.0000	5.0000	5.0000
19.1900	10.0000	10.0000	10.0000	10.0000	10.0000
1000.0000	20.0000	20.0000	20.0000	20.0000	20.0000
11.5500	50.0000	50.0000	50.0000	50.0000	50.0000
7.9700	100.0000	100.0000	100.0000	100.0000	100.0000
2.0000	200.0000	200.0000	200.0000	200.0000	200.0000
5.4000	500.0000	500.0000	500.0000	500.0000	500.0000
10.0000	1000.0000	1000.0000	1000.0000	1000.0000	1000.0000

FOR TOW( 4 ) = 30.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.0300	0.0300	0.0300	0.0300	0.0300
20.0000	0.0500	0.0500	0.0500	0.0500	0.0500
100.0000	0.1000	0.1000	0.1000	0.1000	0.1000
400.0000	0.2000	0.2000	0.2000	0.2000	0.2000
1500.0000	0.5000	0.5000	0.5000	0.5000	0.5000
27.5000	1.0000	1.0000	1.0000	1.0000	1.0000
4000.0000	2.0000	2.0000	2.0000	2.0000	2.0000
29.2000	5.0000	5.0000	5.0000	5.0000	5.0000
1000.0000	10.0000	10.0000	10.0000	10.0000	10.0000
20.4500	20.0000	20.0000	20.0000	20.0000	20.0000
1000.0000	50.0000	50.0000	50.0000	50.0000	50.0000
23.5000	100.0000	100.0000	100.0000	100.0000	100.0000
16.4000	200.0000	200.0000	200.0000	200.0000	200.0000
12.5000	500.0000	500.0000	500.0000	500.0000	500.0000
7.3000	1000.0000	1000.0000	1000.0000	1000.0000	1000.0000

FOR TOW( 5 ) = 40.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.1000	0.1000	0.1000	0.1000	0.1000
20.0000	0.2000	0.2000	0.2000	0.2000	0.2000
100.0000	0.5000	0.5000	0.5000	0.5000	0.5000
400.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1500.0000	2.0000	2.0000	2.0000	2.0000	2.0000
42.6000	5.0000	5.0000	5.0000	5.0000	5.0000
4000.0000	10.0000	10.0000	10.0000	10.0000	10.0000
32.5000	20.0000	20.0000	20.0000	20.0000	20.0000
1000.0000	50.0000	50.0000	50.0000	50.0000	50.0000
22.7000	100.0000	100.0000	100.0000	100.0000	100.0000
30.6500	200.0000	200.0000	200.0000	200.0000	200.0000
23.6000	500.0000	500.0000	500.0000	500.0000	500.0000
12.5000	1000.0000	1000.0000	1000.0000	1000.0000	1000.0000
5.2000	2000.0000	2000.0000	2000.0000	2000.0000	2000.0000
2.0000	5000.0000	5000.0000	5000.0000	5000.0000	5000.0000

FOR TOW( 6 ) = 50.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.3500	0.3500	0.3500	0.3500	0.3500
20.0000	0.7000	0.7000	0.7000	0.7000	0.7000
100.0000	1.4000	1.4000	1.4000	1.4000	1.4000
400.0000	2.8000	2.8000	2.8000	2.8000	2.8000
1500.0000	5.6000	5.6000	5.6000	5.6000	5.6000
66.8000	11.2000	11.2000	11.2000	11.2000	11.2000
4000.0000	22.4000	22.4000	22.4000	22.4000	22.4000
43.5000	44.8000	44.8000	44.8000	44.8000	44.8000
1000.0000	89.6000	89.6000	89.6000	89.6000	89.6000
27.8000	179.2000	179.2000	179.2000	179.2000	179.2000
42.3000	358.4000	358.4000	358.4000	358.4000	358.4000
38.0000	716.8000	716.8000	716.8000	716.8000	716.8000
26.3000	1433.6000	1433.6000	1433.6000	1433.6000	1433.6000
5.3000	2867.2000	2867.2000	2867.2000	2867.2000	2867.2000
2.0000	5734.4000	5734.4000	5734.4000	5734.4000	5734.4000

FOR TOW( 7 ) = 60.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000	0.9700	0.9700	0.9700	0.9700	0.9700
2.0000	1.9400	1.9400	1.9400	1.9400	1.9400
10.0000	9.7000	9.7000	9.7000	9.7000	9.7000
40.0000	38.8000	38.8000	38.8000	38.8000	38.8000
100.0000	97.0000	97.0000	97.0000	97.0000	97.0000
400.0000	194.0000	194.0000	194.0000	194.0000	194.0000
1500.0000	388.0000	388.0000	388.0000	388.0000	388.0000
66.8000	776.0000	776.0000	776.0000	776.0000	776.0000
4000.0000	1552.0000	1552.0000	1552.0000	1552.0000	1552.0000
27.8000	3104.0000	3104.0000	3104.0000	3104.0000	3104.0000
42.3000	6208.0000	6208.0000	6208.0000	6208.0000	6208.0000
38.0000	12416.0000	12416.0000	12416.0000	12416.0000	12416.0000
26.3000	24832.0000	24832.0000	24832.0000	24832.0000	24832.0000
5.3000	49664.0000	49664.0000	49664.0000	49664.0000	49664.0000
2.0000	99328.0000	99328.0000	99328.0000	99328.0000	99328.0000



400.0000	68.2000	700.0000	74.5000	1000.0000	80.7000
1500.0000	91.1000	4000.0000	95.0000		

FOR TOW( 8 ) = 70.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 2.1300	5.0000 46.8000	10.0000 58.0000
20.0000 66.3000	40.0000 73.5000	60.0000 76.7000
100.0000 81.5000	200.0000 86.0000	300.0000 88.4000
400.0000 90.7000	700.0000 98.0000	1000.0000 107.8000
1500.0000 117.5000	4000.0000 122.0000	

FOR TOW( 9 ) = 80.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 4.1200	5.0000 64.7000	10.0000 78.0000
20.0000 88.2000	40.0000 95.7000	60.0000 100.1000
100.0000 105.3000	200.0000 110.0000	300.0000 112.7000
400.0000 115.6000	700.0000 124.0000	1000.0000 132.2000
1500.0000 145.9000	4000.0000 151.0000	

FOR TOW( 10 ) = 100.0000 ,THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 11.8000	5.0000 110.0000	10.0000 127.0000
20.0000 140.0000	30.0000 145.0000	40.0000 147.0000
60.0000 153.0000	100.0000 158.0000	200.0000 162.4000
300.0000 166.0000	400.0000 169.0000	700.0000 179.5000
1000.0000 190.5000	1500.0000 209.0000	4000.0000 215.0000

FOR TOW( 11 ) = 120.0000 ,THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 26.2000	5.0000 163.0000	10.0000 181.0000
20.0000 198.0000	40.0000 208.0000	60.0000 213.0000
100.0000 220.0000	200.0000 227.0000	300.0000 230.5000
400.0000 234.0000	700.0000 245.5000	1000.0000 256.5000
1500.0000 275.0000	4000.0000 282.0000	

FOR TOW( 12 ) = 140.0000 ,THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 48.6000	5.0000 223.0000	10.0000 241.0000
20.0000 261.0000	30.0000 272.0000	40.0000 280.0000
60.0000 288.0000	100.0000 297.0000	200.0000 302.5000
300.0000 306.5000	400.0000 310.5000	700.9000 322.0000
1000.0000 334.0000	1500.0000 353.0000	4000.0000 360.0000

FOR TOW( 13 ) = 160.0000 ,THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
0.0000 79.0000	5.0000 289.0000	10.0000 308.0000
20.0000 325.0000	30.0000 330.0000	40.0000 342.0000
60.0000 348.0000	100.0000 354.0000	200.0000 358.0000
300.0000 363.0000	400.0000 367.5000	700.0000 380.5000
1000.0000 398.0000	1500.0000 415.5000	4000.0000 423.0000

FOR TOW( 14 ) = 180.0000 ,THERE ARE 15 DATA POINTS.



FOR TOW 8 ) = 70.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1200.0000	117.5000	4000.0000	155.0000
400.0000	90.7000	700.0000	98.0000
100.0000	81.5000	500.0000	86.0000
50.0000	68.3000	40.0000	73.5000
0.0000	5.1300	5.0000	46.8000
10.0000	10.0000	10.0000	58.0000
20.0000	26.7000	20.0000	76.7000
30.0000	88.4000	300.0000	107.8000
40.0000	107.8000	1000.0000	

FOR TOW 9 ) = 80.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1200.0000	145.9000	4000.0000	151.0000
400.0000	115.6000	700.0000	124.0000
100.0000	105.3000	500.0000	110.0000
50.0000	88.5000	40.0000	95.7000
0.0000	4.1500	5.0000	64.7000
10.0000	10.0000	10.0000	78.0000
20.0000	100.1000	20.0000	100.1000
30.0000	115.7000	300.0000	135.5000
40.0000	135.5000	1000.0000	

FOR TOW 10 ) = 100.0000 , THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1000.0000	190.5000	1500.0000	209.0000
300.0000	166.0000	400.0000	189.0000
20.0000	123.0000	100.0000	128.0000
50.0000	140.0000	30.0000	145.0000
0.0000	11.8000	5.0000	110.0000
10.0000	127.0000	10.0000	157.0000
20.0000	147.0000	40.0000	179.5000
30.0000	165.4000	200.0000	215.0000
40.0000	179.5000	700.0000	215.0000
100.0000	215.0000	4000.0000	

FOR TOW 11 ) = 120.0000 , THERE ARE 14 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1200.0000	255.0000	4000.0000	285.0000
400.0000	234.0000	700.0000	245.5000
100.0000	220.0000	500.0000	227.0000
50.0000	198.0000	40.0000	208.0000
0.0000	56.5000	5.0000	163.0000
10.0000	181.0000	10.0000	213.0000
20.0000	230.5000	300.0000	256.5000
30.0000	256.5000	1000.0000	

FOR TOW 12 ) = 140.0000 , THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1000.0000	334.0000	1500.0000	353.0000
300.0000	306.5000	400.0000	310.5000
60.0000	288.0000	100.0000	297.0000
50.0000	261.0000	30.0000	275.0000
0.0000	48.6000	5.0000	253.0000
10.0000	241.0000	10.0000	280.0000
20.0000	305.5000	200.0000	325.0000
30.0000	325.0000	700.0000	350.0000
40.0000	350.0000	4000.0000	

FOR TOW 13 ) = 160.0000 , THERE ARE 15 DATA POINTS.

TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE	TIME - SHEAR RATE
1000.0000	398.0000	1500.0000	415.5000
300.0000	363.0000	400.0000	367.5000
60.0000	348.0000	100.0000	354.0000
50.0000	325.0000	30.0000	330.0000
0.0000	79.0000	5.0000	289.0000
10.0000	308.0000	10.0000	345.0000
20.0000	358.0000	200.0000	380.5000
30.0000	380.5000	700.0000	423.0000
40.0000	423.0000	4000.0000	



TIME -	SHEAR RATE	TIME -	SHEAR RATE	TIME -	SHEAR RATE
0.0000	116.0000	5.0000	353.0000	10.0000	375.0000
20.0000	400.0000	30.0000	408.0000	40.0000	412.0000
60.0000	418.0000	100.0000	426.0000	200.0000	432.5000
300.0000	436.5000	400.0000	441.0000	700.0000	453.0000
1000.0000	465.5000	1500.0000	485.5000	4000.0000	493.0000

FOR TOW( 15 ) = 200.0000 ,THERE ARE 15 DATA POINTS.

TIME -	SHEAR RATE	TIME -	SHEAR RATE	TIME -	SHEAR RATE
0.0000	158.0000	5.0000	420.0000	10.0000	443.0000
20.0000	467.0000	30.0000	475.0000	40.0000	481.5000
60.0000	490.0000	100.0000	498.0000	200.0000	503.0000
300.0000	507.5000	400.0000	512.0000	700.0000	525.0000
1000.0000	538.0000	1500.0000	560.0000	4000.0000	568.0000

FOR TOW( 16 ) = 240.0000 ,THERE ARE 15 DATA POINTS.

TIME -	SHEAR RATE	TIME -	SHEAR RATE	TIME -	SHEAR RATE
0.0000	253.0000	5.0000	550.0000	10.0000	576.0000
20.0000	601.0000	30.0000	609.0000	40.0000	615.0000
60.0000	623.0000	100.0000	632.0000	200.0000	637.5000
300.0000	642.0000	400.0000	647.0000	700.0000	661.0000
1000.0000	630.0000	1500.0000	698.0000	4000.0000	705.0000

FOR TOW( 17 ) = 280.0000 ,THERE ARE 15 DATA POINTS.

TIME -	SHEAR RATE	TIME -	SHEAR RATE	TIME -	SHEAR RATE
0.0000	356.0000	5.0000	679.0000	10.0000	705.0000
20.0000	737.0000	30.0000	746.0000	40.0000	752.5000
60.0000	762.0000	100.0000	771.0000	200.0000	776.5000
300.0000	781.0000	400.0000	785.5000	700.0000	799.0000
1000.0000	812.5000	1500.0000	835.0000	4000.0000	843.0000

FOR TOW( 18 ) = 320.0000 ,THERE ARE 15 DATA POINTS.

TIME -	SHEAR RATE	TIME -	SHEAR RATE	TIME -	SHEAR RATE
0.0000	463.0000	5.0000	800.0000	10.0000	837.0000
20.0000	867.0000	30.0000	786.0000	40.0000	882.0000
60.0000	892.0000	100.0000	902.0000	200.0000	909.0000
300.0000	913.0000	400.0000	917.5000	700.0000	931.0000
1000.0000	944.0000	1500.0000	965.0000	4000.0000	973.0000



1000.0000	452.5000	1500.0000	482.5000	4000.0000	493.0000
300.0000	436.5000	400.0000	441.0000	100.0000	423.0000
60.0000	418.0000	100.0000	426.0000	500.0000	435.5000
50.0000	400.0000	30.0000	408.0000	40.0000	415.0000
0.0000	118.0000	2.0000	323.0000	10.0000	375.0000

FOR TOW ( 15 ) = 500.0000 , THERE ARE 12 DATA POINTS.

1000.0000	538.0000	1200.0000	560.0000	4000.0000	568.0000
300.0000	503.5000	400.0000	515.0000	100.0000	552.0000
60.0000	490.0000	100.0000	498.0000	500.0000	503.0000
50.0000	467.0000	30.0000	472.0000	40.0000	481.5000
0.0000	128.0000	2.0000	450.0000	10.0000	443.0000

FOR TOW ( 16 ) = 540.0000 , THERE ARE 12 DATA POINTS.

1000.0000	630.0000	1200.0000	658.0000	4000.0000	702.0000
300.0000	645.0000	400.0000	647.0000	100.0000	661.0000
60.0000	623.0000	100.0000	632.0000	500.0000	637.5000
50.0000	601.0000	30.0000	609.0000	40.0000	612.0000
0.0000	523.0000	2.0000	520.0000	10.0000	576.0000

FOR TOW ( 17 ) = 580.0000 , THERE ARE 12 DATA POINTS.

1000.0000	812.5000	1200.0000	832.0000	4000.0000	843.0000
300.0000	781.0000	400.0000	782.5000	100.0000	799.0000
60.0000	765.0000	100.0000	771.0000	500.0000	778.5000
50.0000	737.0000	30.0000	746.0000	40.0000	725.5000
0.0000	326.0000	2.0000	679.0000	10.0000	702.0000

FOR TOW ( 18 ) = 350.0000 , THERE ARE 12 DATA POINTS.

1000.0000	944.0000	1200.0000	962.0000	4000.0000	973.0000
300.0000	913.0000	400.0000	917.5000	100.0000	931.0000
60.0000	892.0000	100.0000	902.0000	500.0000	909.0000
50.0000	867.0000	30.0000	886.0000	40.0000	885.0000
0.0000	463.0000	2.0000	800.0000	10.0000	837.0000

THE AVERAGE VELOCITY IS 1.2411 FT/SEC.

THE DENSITY OF THE FLUID IS 54.200 LB/CU FT.

THE FLOW RATE IS 15000.000 BBL/DAY OR,

THE FLOW RATE IS 0.97474999 CUBIC FEET PER SEC.

THE FLOW RATE IS 0.97474999 CUBIC FEET PER SEC.

THE RADIUS OF THE PIPE IS 0.50 FT.

THE PLUG RADIUS IS 0.00000 FT.

THE AVG. VELOCITY IS THEN 1.2411 FT/SEC.

THE DENSITY OF THE FLUID IS 54.200 LB/CU FT.

ITS LIMITING SHEAR STRESS IS 0.000 LB/SQ FT.

7 FLOW AGES ARE CALCULATED.



THE FLOW RATE IS 15000.000 BR/LAY OR,

THE FLOW RATE IS 0.974999 CUBIC FEET PER SEC.

THE RADIUS OF THE PIPE IS 0.20 FT.

THE PLUG RADIUS IS 0.00000 FT.

THE AVG. VELOCITY IS THEN 1.541 FT/SEC.

THE DENSITY OF THE FLUID IS 24.500 LB/CU FT.

ITS LIMITING SHEAR STRESS IS 0.000 LB/20 FT.

7 FLOW AGES ARE CALCULATED.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 1 .

AT 0.000 FEET, THE PRESSURE GRADIENT IS 0.0010666 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.0000
2	0.48412	0.21339	0.0154927	10.0000
3	0.46771	0.41601	0.0251661	10.0000
4	0.45069	0.60745	0.0342811	10.0000
5	0.43301	0.78732	0.0428171	10.0000
6	0.41458	0.95517	0.0507523	10.0000
7	0.39528	1.11056	0.0580688	10.0000
8	0.37500	1.25324	0.0647604	10.0000
9	0.35355	1.38317	0.0708180	10.0000
10	0.33072	1.49997	0.0762199	10.0000
11	0.30619	1.60317	0.0809417	10.0000
12	0.27951	1.69225	0.0849569	10.0000
13	0.25000	1.76669	0.0882575	10.0000
14	0.21651	1.82669	0.0908484	10.0000
15	0.17678	1.87206	0.0927242	10.0000
16	0.12500	1.90210	0.0933690	10.0000
	0.00000	1.92550		

THE REYNOLDS NO. IS 0.54016266E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 1 .

AT 0.000 FEET, THE PRESSURE GRADIENT IS 0.0010000 LB/IN<sup>2</sup> INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	10.0000
2	0.48412	0.21339	0.0124927	10.0000
3	0.46771	0.41001	0.0231661	10.0000
4	0.42069	0.60742	0.0342811	10.0000
5	0.43301	0.78732	0.0458171	10.0000
6	0.41428	0.92217	0.0507253	10.0000
7	0.39228	1.11029	0.0590688	10.0000
8	0.37200	1.22324	0.0647204	10.0000
9	0.32322	1.38317	0.0708180	10.0000
10	0.33022	1.49997	0.0725199	10.0000
11	0.30619	1.60317	0.0809417	10.0000
12	0.27921	1.69222	0.0849299	10.0000
13	0.22000	1.79999	0.0882272	10.0000
14	0.21621	1.82999	0.0908484	10.0000
15	0.17978	1.97206	0.0925242	10.0000
16	0.12200	1.90210	0.0933990	10.0000
	0.00000	1.92220		

THE RADIUS NO. IS 0.24016666 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 2 .

AT 0.050 FEET, THE PRESSURE GRADIENT IS 0.0010666 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.0076
2	0.48393	0.21595	0.0154927	10.0026
3	0.46761	0.41725	0.0251661	10.0016
4	0.45063	0.60825	0.0342811	10.0012
5	0.43296	0.78791	0.0428171	10.0010
6	0.41453	0.95563	0.0507523	10.0008
7	0.39525	1.11093	0.0580688	10.0007
8	0.37497	1.25354	0.0647604	10.0006
9	0.35352	1.38342	0.0708180	10.0006
10	0.33069	1.50018	0.0762199	10.0005
11	0.30616	1.60335	0.0809417	10.0005
12	0.27948	1.69240	0.0849569	10.0005
13	0.24998	1.76681	0.0882575	10.0005
14	0.21648	1.82679	0.0908484	10.0004
15	0.17675	1.87214	0.0927242	10.0004
16	0.12497	1.90217	0.0933690	10.0004
	0.00000	1.92556		

THE RENOLDS NO. IS 0.54017352E 03 .



THE REYNOLDS NO. IS 0.2401325E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.92220	0.0033000	10.0004
2	0.12497	1.90517	0.0032745	10.0004
3	0.24994	1.88814	0.0032490	10.0004
4	0.37491	1.87111	0.0032235	10.0004
5	0.49988	1.85408	0.0031980	10.0004
6	0.62485	1.83705	0.0031725	10.0004
7	0.74982	1.82002	0.0031470	10.0004
8	0.87479	1.80299	0.0031215	10.0004
9	0.99976	1.78596	0.0030960	10.0004
10	1.12473	1.76893	0.0030705	10.0004
11	1.24970	1.75190	0.0030450	10.0004
12	1.37467	1.73487	0.0030195	10.0004
13	1.49964	1.71784	0.0029940	10.0004
14	1.62461	1.70081	0.0029685	10.0004
15	1.74958	1.68378	0.0029430	10.0004
16	1.87455	1.66675	0.0029175	10.0004
17	1.99952	1.64972	0.0028920	10.0004
18	2.12449	1.63269	0.0028665	10.0004
19	2.24946	1.61566	0.0028410	10.0004
20	2.37443	1.59863	0.0028155	10.0004
21	2.49940	1.58160	0.0027900	10.0004
22	2.62437	1.56457	0.0027645	10.0004
23	2.74934	1.54754	0.0027390	10.0004
24	2.87431	1.53051	0.0027135	10.0004
25	2.99928	1.51348	0.0026880	10.0004
26	3.12425	1.49645	0.0026625	10.0004
27	3.24922	1.47942	0.0026370	10.0004
28	3.37419	1.46239	0.0026115	10.0004
29	3.49916	1.44536	0.0025860	10.0004
30	3.62413	1.42833	0.0025605	10.0004
31	3.74910	1.41130	0.0025350	10.0004
32	3.87407	1.39427	0.0025095	10.0004
33	3.99904	1.37724	0.0024840	10.0004
34	4.12401	1.36021	0.0024585	10.0004
35	4.24898	1.34318	0.0024330	10.0004
36	4.37395	1.32615	0.0024075	10.0004
37	4.49892	1.30912	0.0023820	10.0004
38	4.62389	1.29209	0.0023565	10.0004
39	4.74886	1.27506	0.0023310	10.0004
40	4.87383	1.25803	0.0023055	10.0004
41	4.99880	1.24100	0.0022800	10.0004
42	5.12377	1.22397	0.0022545	10.0004
43	5.24874	1.20694	0.0022290	10.0004
44	5.37371	1.18991	0.0022035	10.0004
45	5.49868	1.17288	0.0021780	10.0004
46	5.62365	1.15585	0.0021525	10.0004
47	5.74862	1.13882	0.0021270	10.0004
48	5.87359	1.12179	0.0021015	10.0004
49	5.99856	1.10476	0.0020760	10.0004
50	6.12353	1.08773	0.0020505	10.0004
51	6.24850	1.07070	0.0020250	10.0004
52	6.37347	1.05367	0.0020000	10.0004

AT 0.020 FEET, THE PRESSURE GRADIENT IS 0.0010666 LB/20 IN/FT.  
THE INCREMENT NUMBER IN LENGTH IS 5 .  
THE AGE OF FLOW IS 4000.0000 MIN.

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 3 .

AT 0.100 FEET, THE PRESSURE GRADIENT IS 0.0010666 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0152
	0.48393	0.21598		
2			0.0154927	10.0052
	0.46761	0.41726		
3			0.0251661	10.0032
	0.45063	0.60825		
4			0.0342811	10.0024
	0.43297	0.78788		
5			0.0428171	10.0019
	0.41455	0.95559		
6			0.0507523	10.0016
	0.39526	1.11089		
7			0.0580688	10.0014
	0.37498	1.25350		
8			0.0647604	10.0013
	0.35354	1.38338		
9			0.0708180	10.0012
	0.33071	1.50015		
10			0.0762199	10.0011
	0.30617	1.60332		
11			0.0809417	10.0010
	0.27950	1.69238		
12			0.0849569	10.0010
	0.24999	1.76680		
13			0.0882575	10.0009
	0.21650	1.82678		
14			0.0908484	10.0009
	0.17677	1.87214		
15			0.0927242	10.0009
	0.12499	1.90218		
16			0.0933690	10.0009
	0.00000	1.92557		

THE RENOLDS NO. IS 0.54019012E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 3 .

AT 0.100 FEET, THE PRESSURE GRADIENT IS 0.0010666 LB/IN<sup>2</sup> INVT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	10.0125
2	0.48393	0.51298	0.0124957	10.0025
3	0.46761	0.41756	0.0251661	10.0035
4	0.42063	0.60852	0.0345911	10.0054
5	0.43597	0.18188	0.0458171	10.0019
6	0.41452	0.92229	0.0201253	10.0016
7	0.39256	1.11089	0.0280688	10.0014
8	0.37498	1.52320	0.0647604	10.0013
9	0.35354	1.38338	0.0703180	10.0015
10	0.33071	1.26012	0.0765199	10.0011
11	0.30917	1.60332	0.0809417	10.0010
12	0.27920	1.69538	0.0849269	10.0010
13	0.24699	1.76980	0.0805272	10.0009
14	0.21620	1.82978	0.0808484	10.0009
15	0.17677	1.87514	0.0452545	10.0009
16	0.12499	1.90518	0.0433690	10.0009
	0.00000	1.92227		

THE REYNOLDS NO. IS 0.240190156 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 4 .

AT 0.200 FEET, THE PRESSURE GRADIENT IS 0.0010665 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0303
	0.48394	0.21606		
2			0.0154927	10.0105
	0.46762	0.41733		
3			0.0251661	10.0065
	0.45064	0.60831		
4			0.0342811	10.0048
	0.43298	0.78792		
5			0.0428171	10.0038
	0.41456	0.95561		
6			0.0507523	10.0032
	0.39527	1.11090		
7			0.0580688	10.0028
	0.37500	1.25350		
8			0.0647604	10.0025
	0.35356	1.38338		
9			0.0708180	10.0023
	0.33073	1.50014		
10			0.0762199	10.0021
	0.30620	1.60332		
11			0.0809417	10.0020
	0.27952	1.69237		
12			0.0849569	10.0019
	0.25002	1.76680		
13			0.0882575	10.0019
	0.21653	1.82679		
14			0.0908484	10.0018
	0.17681	1.87216		
15			0.0927242	10.0018
	0.12505	1.90221		
16			0.0933690	10.0017
	0.00000	1.92562		

THE RENOLDS NO. IS 0.54022028E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 4 .

AT 0.200 FEET, THE PRESSURE GRADIENT IS 0.0010665 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025729	10.0303
2	0.48334	0.51809	0.0124927	10.0102
3	0.66762	0.41733	0.0271681	10.0062
4	0.42064	0.60831	0.0342811	10.0048
5	0.43238	0.78792	0.0428171	10.0038
6	0.41426	0.92261	0.0207223	10.0032
7	0.39927	1.11090	0.0280688	10.0028
8	0.37200	1.22320	0.047604	10.0022
9	0.32326	1.38338	0.0708180	10.0023
10	0.33073	1.20014	0.0725199	10.0021
11	0.30620	1.60332	0.0809417	10.0020
12	0.27922	1.69237	0.0849299	10.0019
13	0.22002	1.76680	0.0852272	10.0019
14	0.21623	1.82649	0.0808484	10.0018
15	0.17681	1.87219	0.0925242	10.0018
16	0.12202	1.90221	0.0933890	10.0017
	0.00000	1.92262		

THE RESULTS NO. IS 0.24052059E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 5 .

AT 0.300 FEET, THE PRESSURE GRADIENT IS 0.0010664 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0454
	0.48395	0.21613		
2			0.0154927	10.0157
	0.46763	0.41736		
3			0.0251661	10.0097
	0.45065	0.60833		
4			0.0342811	10.0071
	0.43299	0.78792		
5			0.0428171	10.0057
	0.41457	0.95560		
6			0.0507523	10.0048
	0.39529	1.11089		
7			0.0580688	10.0042
	0.37501	1.25348		
8			0.0647604	10.0038
	0.35357	1.38335		
9			0.0708180	10.0035
	0.33074	1.50011		
10			0.0762199	10.0032
	0.30621	1.60328		
11			0.0809417	10.0030
	0.27954	1.69233		
12			0.0849569	10.0029
	0.25004	1.76675		
13			0.0882575	10.0028
	0.21655	1.82675		
14			0.0908484	10.0027
	0.17684	1.87212		
15			0.0927242	10.0026
	0.12509	1.90217		
16			0.0933690	10.0026
	0.00000	1.92560		

THE RENOLDS NO. IS 0.54025751E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 2 .

AT 0.300 FEET, THE PRESSURE GRADIENT IS 0.0010684 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025129	10.0424
2	0.48192	0.51613	0.0124957	10.0127
3	0.46763	0.41736	0.0521681	10.0037
4	0.45082	0.60833	0.0345811	10.0071
5	0.43299	0.78792	0.0458171	10.0027
6	0.41427	0.92260	0.0207253	10.0048
7	0.39229	1.11089	0.0280288	10.0042
8	0.37201	1.22348	0.0647604	10.0038
9	0.35327	1.38332	0.0708180	10.0032
10	0.33074	1.20011	0.0725199	10.0032
11	0.30921	1.60328	0.0809417	10.0030
12	0.27924	1.69237	0.0849299	10.0029
13	0.25004	1.76672	0.0892272	10.0029
14	0.21622	1.82972	0.0908484	10.0027
15	0.17684	1.87212	0.0921242	10.0029
16	0.12209	1.40517	0.0933990	10.0029
	0.00000	1.92260		

THE REYNOLDS NO. IS 0.2402251E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 6 .

AT 0.500 FEET, THE PRESSURE GRADIENT IS 0.0010663 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0756
	0.48396	0.21627		
2			0.0154927	10.0261
	0.46765	0.41742		
3			0.0251661	10.0162
	0.45068	0.60836		
4			0.0342811	10.0119
	0.43301	0.78794		
5			0.0428171	10.0095
	0.41459	0.95561		
6			0.0507523	10.0080
	0.39531	1.11086		
7			0.0580688	10.0070
	0.37504	1.25343		
8			0.0647604	10.0063
	0.35360	1.38329		
9			0.0708180	10.0058
	0.33077	1.50004		
10			0.0762199	10.0054
	0.30625	1.60320		
11			0.0809417	10.0050
	0.27958	1.69226		
12			0.0849569	10.0048
	0.25008	1.76668		
13			0.0882575	10.0046
	0.21660	1.82667		
14			0.0908484	10.0045
	0.17689	1.87205		
15			0.0927242	10.0044
	0.12516	1.90211		
16			0.0933690	10.0043
	0.00000	1.92557		

THE RENOLDS NO. IS 0.54032970E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 6 .

AT 0.200 FEET, THE PRESSURE GRADIENT IS 0.0010683 18720 INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	10.0256
2	0.48328	0.21627	0.0124427	10.0251
3	0.46762	0.41742	0.0251661	10.0182
4	0.42068	0.60836	0.0342811	10.0117
5	0.43701	0.78794	0.0428171	10.0092
6	0.41429	0.92261	0.0207223	10.0080
7	0.39231	1.11086	0.0280688	10.0070
8	0.37204	1.27373	0.0647604	10.0023
9	0.32320	1.38329	0.0708180	10.0028
10	0.33077	1.20004	0.0762139	10.0024
11	0.30622	1.60320	0.0809417	10.0020
12	0.27329	1.62356	0.0849269	10.0048
13	0.22008	1.76668	0.0872272	10.0046
14	0.21660	1.62667	0.0908484	10.0042
15	0.17889	1.87202	0.0925242	10.0044
16	0.12216	1.90211	0.0933690	10.0043
	0.00000	1.92227		

THE REYNOLDS NO. IS 0.24032910E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 7 .

AT 0.700 FEET, THE PRESSURE GRADIENT IS 0.0010662 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48397	0.21639	0.0052759	10.1058
2	0.46767	0.41748	0.0154927	10.0366
3	0.45070	0.60839	0.0251661	10.0226
4	0.43304	0.78795	0.0342811	10.0167
5	0.41462	0.95558	0.0428171	10.0133
6	0.39534	1.11083	0.0507523	10.0113
7	0.37506	1.25339	0.0580688	10.0098
8	0.35363	1.38324	0.0647604	10.0088
9	0.33080	1.49998	0.0708180	10.0081
10	0.30628	1.60314	0.0762199	10.0075
11	0.27961	1.69219	0.0809417	10.0071
12	0.25012	1.76661	0.0849569	10.0067
13	0.21664	1.82662	0.0882575	10.0065
14	0.17695	1.87200	0.0908484	10.0063
15	0.12525	1.90207	0.0927242	10.0062
16	0.00000	1.92556	0.0933690	10.0061

THE RENOLDS NO. IS 0.54039767E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 1

AT 0.700 FEET, THE PRESSURE GRADIENT IS 0.0010662 LBS/IN<sup>2</sup>

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025252	10.1028
2	0.48333	0.21632	0.0124452	10.0388
3	0.46767	0.41748	0.0521661	10.0556
4	0.45070	0.60832	0.0345811	10.0167
5	0.43304	0.78325	0.0458171	10.0133
6	0.41465	0.92228	0.0207252	10.0113
7	0.39534	1.11083	0.0288888	10.0038
8	0.37506	1.25332	0.0647804	10.0088
9	0.35363	1.38354	0.0708180	10.0081
10	0.33080	1.49438	0.0725139	10.0072
11	0.30658	1.60314	0.0802412	10.0071
12	0.27981	1.69259	0.0844269	10.0027
13	0.25015	1.76061	0.0885272	10.0022
14	0.21664	1.82885	0.0906484	10.0023
15	0.17602	1.87500	0.0927245	10.0025
16	0.12522	1.90501	0.0933690	10.0021
	0.00000	1.92226		

THE REMOVAL NO. IS 0.24032707E 03



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 8 .

AT 1.100 FEET, THE PRESSURE GRADIENT IS 0.0010659 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.1660
	0.48398	0.21665		
2			0.0154927	10.0574
	0.46770	0.41762		
3			0.0251661	10.0356
	0.45073	0.60847		
4			0.0342811	10.0252
	0.43308	0.78798		
5			0.0428171	10.0210
	0.41466	0.95559		
6			0.0507523	10.0177
	0.39538	1.11081		
7			0.0580688	10.0155
	0.37511	1.25335		
8			0.0647604	10.0139
	0.35368	1.38317		
9			0.0708180	10.0127
	0.33085	1.49989		
10			0.0762199	10.0118
	0.30633	1.60304		
11			0.0809417	10.0111
	0.27967	1.69208		
12			0.0849569	10.0106
	0.25019	1.76649		
13			0.0882575	10.0102
	0.21672	1.82649		
14			0.0908484	10.0099
	0.17705	1.87189		
15			0.0927242	10.0097
	0.12539	1.90198		
16			0.0933690	10.0096
	0.00000	1.92552		

THE RENOLDS NO. IS 0.54053135E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 8 .

AT 1.100 FEET, THE PRESSURE GRADIENT IS 0.0010529 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025529	10.1450
2	0.48398	0.21662	0.0124957	10.0274
3	0.46770	0.41782	0.0221661	10.0329
4	0.45073	0.60847	0.0315811	10.0525
5	0.43308	0.78798	0.0408171	10.0510
6	0.41466	0.95229	0.0501253	10.0177
7	0.39538	1.11001	0.0590688	10.0122
8	0.37511	1.25332	0.0671604	10.0130
9	0.35398	1.38317	0.0708180	10.0157
10	0.33002	1.49989	0.0725199	10.0118
11	0.30633	1.60304	0.0809477	10.0111
12	0.27997	1.69208	0.0849299	10.0109
13	0.25019	1.76649	0.0892579	10.0102
14	0.21972	1.82649	0.0908484	10.0099
15	0.17702	1.87199	0.0927542	10.0097
16	0.12279	1.90199	0.0933990	10.0099
	0.00000	1.92222		

THE REYNOLDS NO. IS 0.24023132E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 9 .

AT 1.500 FEET, THE PRESSURE GRADIENT IS 0.0010657 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.2262
2	0.48400	0.21686	0.0154927	10.0783
3	0.46773	0.41774	0.0251661	10.0485
4	0.45077	0.60853	0.0342811	10.0357
5	0.43312	0.78800	0.0428171	10.0286
6	0.41470	0.95558	0.0507523	10.0241
7	0.39543	1.11077	0.0580688	10.0211
8	0.37516	1.25328	0.0647604	10.0189
9	0.35373	1.38309	0.0708180	10.0173
10	0.33091	1.49980	0.0762199	10.0161
11	0.30639	1.60293	0.0809417	10.0151
12	0.27974	1.69197	0.0849569	10.0144
13	0.25026	1.76639	0.0882575	10.0139
14	0.21680	1.82639	0.0908484	10.0135
15	0.17715	1.87180	0.0927242	10.0132
16	0.12553	1.90192	0.0933690	10.0130
	0.00000	1.92551		

THE RENOLDS NO. IS 0.54065609E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 2 .

AT 1.500 FEET, THE PRESSURE GRADIENT IS 0.0010627 LBS/INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025259	10.5285
2	0.48400	0.51688	0.0124453	10.0783
3	0.46733	0.41739	0.0521961	10.0485
4	0.45077	0.60953	0.0345811	10.0357
5	0.43315	0.78800	0.0450171	10.0588
6	0.41470	0.92528	0.0507553	10.0541
7	0.39543	1.11077	0.0580888	10.0511
8	0.37518	1.52358	0.0647004	10.0189
9	0.35373	1.38309	0.0708180	10.0173
10	0.33091	1.49980	0.0745199	10.0181
11	0.30639	1.60593	0.0809413	10.0151
12	0.27979	1.69197	0.0849599	10.0144
13	0.25059	1.76939	0.0885252	10.0139
14	0.21880	1.82839	0.0908484	10.0135
15	0.17715	1.87180	0.0925245	10.0135
16	0.12523	1.90195	0.0933690	10.0130
	0.00000	1.92521		

THE REYNOLDS NO. IS 0.2402509E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 2.300 FEET, THE PRESSURE GRADIENT IS 0.0010648 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.3464
	0.48402	0.21715		
2			0.0154927	10.1200
	0.46776	0.41782		
3			0.0251661	10.0744
	0.45079	0.60844		
4			0.0342811	10.0547
	0.43313	0.78776		
5			0.0428171	10.0439
	0.41471	0.95519		
6			0.0507523	10.0370
	0.39542	1.11023		
7			0.0580688	10.0324
	0.37513	1.25262		
8			0.0647604	10.0290
	0.35368	1.38230		
9			0.0708180	10.0265
	0.33084	1.49888		
10			0.0762199	10.0247
	0.30630	1.60187		
11			0.0809417	10.0232
	0.27961	1.69076		
12			0.0849569	10.0221
	0.25009	1.76502		
13			0.0882575	10.0213
	0.21657	1.82489		
14			0.0908484	10.0207
	0.17681	1.87016		
15			0.0927242	10.0203
	0.12499	1.90013		
16			0.0933690	10.0200
	0.00000	1.92351		

THE RENOLDS NO. IS 0.54109845E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 5.300 FEET, THE PRESSURE GRADIENT IS 0.0010848 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.002559	10.3484
2	0.48405	0.51715	0.015495	10.1500
3	0.46770	0.41705	0.052188	10.0744
4	0.45079	0.60844	0.034581	10.0247
5	0.43313	0.78176	0.045817	10.0439
6	0.41471	0.95219	0.050753	10.0370
7	0.39545	1.11053	0.058088	10.0354
8	0.37513	1.25585	0.064780	10.0590
9	0.35388	1.39530	0.070818	10.0522
10	0.33084	1.49898	0.075519	10.0547
11	0.30630	1.60187	0.080477	10.0535
12	0.28081	1.69076	0.084929	10.0551
13	0.25509	1.76505	0.088527	10.0513
14	0.21857	1.85489	0.090848	10.0507
15	0.17681	1.87016	0.092545	10.0503
16	0.15499	1.90013	0.093389	10.0500
	0.00000	1.95351		

THE REYNOLDS NO. IS 0.24109845E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11 .

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.0010646 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.4662
2	0.48405	0.21748	0.0154927	10.1616
3	0.46780	0.41807	0.0251661	10.1002
4	0.45085	0.60865	0.0342811	10.0737
5	0.43321	0.78795	0.0428171	10.0591
6	0.41479	0.95537	0.0507523	10.0499
7	0.39552	1.11042	0.0580688	10.0436
8	0.37524	1.25282	0.0647604	10.0391
9	0.35381	1.38252	0.0708180	10.0358
10	0.33099	1.49911	0.0762199	10.0333
11	0.30646	1.60215	0.0809417	10.0313
12	0.27980	1.69108	0.0849569	10.0298
13	0.25031	1.76541	0.0882575	10.0287
14	0.21685	1.82534	0.0908484	10.0279
15	0.17717	1.87070	0.0927242	10.0273
16	0.12553	1.90078	0.0933690	10.0269
	0.00000	1.92437		

THE RENOLDS NO. IS 0.54121687E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11 .

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.0010644 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	10.4685
2	0.48405	0.51748	0.0124957	10.1616
3	0.48780	0.41807	0.0251661	10.1005
4	0.42082	0.60865	0.0345811	10.0737
5	0.43351	0.78795	0.0458171	10.0591
6	0.41479	0.92237	0.0507553	10.0499
7	0.39255	1.11045	0.0280688	10.0436
8	0.37554	1.52585	0.0647604	10.0391
9	0.32381	1.39525	0.0708180	10.0328
10	0.33099	1.49911	0.0765199	10.0333
11	0.30646	1.60515	0.0809417	10.0313
12	0.57980	1.69108	0.0849269	10.0298
13	0.52037	1.76241	0.0885252	10.0287
14	0.51682	1.82534	0.0908484	10.0279
15	0.17717	1.87070	0.0927545	10.0273
16	0.15253	1.90078	0.0933690	10.0269
	0.00000	1.95437		

THE REYNOLDS NO. IS 0.24151876 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 12 .

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010634 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.7058
2	0.48407	0.21773	0.0154927	10.2449
3	0.46783	0.41823	0.0251661	10.1519
4	0.45088	0.60867	0.0342811	10.1118
5	0.43323	0.78780	0.0428171	10.0896
6	0.41481	0.95506	0.0507523	10.0757
7	0.39552	1.10994	0.0580688	10.0661
8	0.37523	1.25219	0.0647604	10.0593
9	0.35378	1.38175	0.0708180	10.0543
10	0.33093	1.49821	0.0762199	10.0504
11	0.30639	1.60109	0.0809417	10.0475
12	0.27969	1.68986	0.0849569	10.0452
13	0.25016	1.76402	0.0882575	10.0436
14	0.21663	1.82381	0.0908484	10.0423
15	0.17686	1.86902	0.0927242	10.0415
16	0.12502	1.89895	0.0933690	10.0408
	0.00000	1.92234		

THE RENOLDS NO. IS 0.54179111E 03 .



THE REYNOLDS NO. IS 0.241711E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	10.2028
2	0.48403	0.21333	0.0124927	10.2449
3	0.46183	0.41823	0.0251661	10.1219
4	0.42088	0.60867	0.0342811	10.1118
5	0.43323	0.78180	0.0428171	10.0899
6	0.41481	0.92208	0.0502523	10.0727
7	0.39222	1.10999	0.0580288	10.0661
8	0.37223	1.22519	0.0647904	10.0593
9	0.35238	1.38122	0.0708180	10.0543
10	0.33093	1.49821	0.0762199	10.0504
11	0.30939	1.60109	0.0802477	10.0472
12	0.27989	1.68986	0.0843299	10.0422
13	0.22018	1.76402	0.0882222	10.0439
14	0.21693	1.82381	0.0908484	10.0423
15	0.17689	1.86902	0.0922242	10.0412
16	0.12202	1.88822	0.0933990	10.0408
	0.00000	1.82234		

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010234 LB/20 IN/FT.

THE INCREMENT NUMBER IN LENGTH IS 12 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 13 .

AT 6.300 FEET, THE PRESSURE GRADIENT IS 0.0010628 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.9450
2	0.48407	0.21777	0.0154927	10.3281
3	0.46784	0.41843	0.0251661	10.2036
4	0.45089	0.60884	0.0342811	10.1499
5	0.43325	0.78792	0.0428171	10.1201
6	0.41483	0.95511	0.0507523	10.1014
7	0.39554	1.10994	0.0580688	10.0887
8	0.37526	1.25215	0.0647604	10.0795
9	0.35381	1.38166	0.0708180	10.0727
10	0.33096	1.49806	0.0762199	10.0676
11	0.30641	1.60089	0.0809417	10.0637
12	0.27971	1.68963	0.0849569	10.0607
13	0.25018	1.76375	0.0882575	10.0584
14	0.21665	1.82350	0.0908484	10.0567
15	0.17687	1.86868	0.0927242	10.0556
16	0.12502	1.89859	0.0933690	10.0547
	0.00000	1.92199		

THE RENOLDS NO. IS 0.54211727E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 13 .

AT 6.300 FEET, THE PRESSURE GRADIENT IS 0.0010858 LB/IN<sup>2</sup> INVT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	10.9990
2	0.48403	0.21777	0.0124927	10.3281
3	0.46784	0.41843	0.0251661	10.2038
4	0.42089	0.60884	0.0342811	10.1499
5	0.43322	0.78192	0.0428171	10.1201
6	0.41483	0.92211	0.0507223	10.1014
7	0.39224	1.10994	0.0580988	10.0887
8	0.37226	1.2212	0.0647804	10.0792
9	0.32381	1.38166	0.0708180	10.0757
10	0.33096	1.49906	0.0762599	10.0679
11	0.30641	1.60099	0.0809417	10.0637
12	0.27971	1.68963	0.0849969	10.0607
13	0.22018	1.76372	0.0882222	10.0584
14	0.21662	1.83320	0.0908484	10.0597
15	0.17687	1.86968	0.0927242	10.0522
16	0.12202	1.99829	0.0933690	10.0547
	0.00000	1.92199		

THE RADIUS NO. IS 0.2421127E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 9.500 FEET, THE PRESSURE GRADIENT IS 0.0010620 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	11.4256
	0.48403	0.21715		
2			0.0154927	10.4948
	0.46778	0.41858		
3			0.0251661	10.3070
	0.45084	0.60915		
4			0.0342811	10.2260
	0.43320	0.78829		
5			0.0428171	10.1812
	0.41479	0.95550		
6			0.0507523	10.1529
	0.39551	1.11036		
7			0.0580688	10.1337
	0.37523	1.25257		
8			0.0647604	10.1200
	0.35378	1.38207		
9			0.0708180	10.1097
	0.33094	1.49844		
10			0.0762199	10.1020
	0.30639	1.60123		
11			0.0809417	10.0960
	0.27970	1.68991		
12			0.0849569	10.0915
	0.25017	1.76397		
13			0.0882575	10.0881
	0.21664	1.82367		
14			0.0908484	10.0856
	0.17687	1.86882		
15			0.0927242	10.0839
	0.12502	1.89872		
16			0.0933690	10.0826
	0.00000	1.92214		

THE RENOLDS NO. IS 0.54249733E 03 .



THE AGE OF FLOW IS 4000+0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 2.500 FEET, THE PRESSURE GRADIENT IS 0.0010250 LB/250 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	11.4220
2	0.48403	0.21712	0.0124927	10.4948
3	0.46178	0.41828	0.0221681	10.3070
4	0.42064	0.60912	0.0345811	10.2520
5	0.43320	0.78829	0.0458171	10.1812
6	0.41479	0.92220	0.0503223	10.1229
7	0.39221	1.11039	0.0580688	10.1337
8	0.37223	1.22227	0.0647804	10.1500
9	0.32378	1.38207	0.0708180	10.1097
10	0.33034	1.44394	0.0722199	10.1020
11	0.30639	1.60123	0.0809417	10.0920
12	0.27970	1.68991	0.0849299	10.0912
13	0.22017	1.76397	0.0822222	10.0981
14	0.21064	1.82397	0.0908484	10.0820
15	0.17687	1.86892	0.0921242	10.0839
16	0.12202	1.89872	0.0933940	10.0820
	0.00000	1.92219		

THE RADIUS NO. IS 0.2424233E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 15 .

AT 12.700 FEET, THE PRESSURE GRADIENT IS 0.0010620 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48393	0.21585	0.0052759	11.9099
2	0.46764	0.41854	0.0154927	10.6619
3	0.45071	0.60955	0.0251661	10.4105
4	0.43308	0.78890	0.0342811	10.3021
5	0.41468	0.95627	0.0428171	10.2422
6	0.39541	1.11125	0.0507523	10.2044
7	0.37514	1.25358	0.0580688	10.1788
8	0.35371	1.38316	0.0647604	10.1603
9	0.33089	1.49961	0.0708180	10.1467
10	0.30636	1.60245	0.0762199	10.1363
11	0.27969	1.69117	0.0809417	10.1284
12	0.25018	1.76526	0.0849569	10.1223
13	0.21668	1.82500	0.0882575	10.1178
14	0.17695	1.87018	0.0908484	10.1144
15	0.12518	1.90013	0.0927242	10.1121
16	0.00000	1.92364	0.0933690	10.1104

THE RENOLDS NO. IS 0.54253830E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 12 .

AT 12.700 FEET, THE PRESSURE GRADIENT IS 0.0010850 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FEET)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	11.9099
2	0.40000	0.21889	0.0124927	10.8619
3	0.60000	0.41824	0.0271681	10.4102
4	0.80000	0.60922	0.0342811	10.3021
5	0.93308	0.78890	0.0428171	10.2422
6	0.94469	0.92627	0.0507253	10.2044
7	0.93241	1.11122	0.0580888	10.1788
8	0.92214	1.22328	0.0647604	10.1603
9	0.92371	1.38316	0.0708180	10.1497
10	0.93089	1.49991	0.0762199	10.1383
11	0.90636	1.60242	0.0809417	10.1284
12	0.92999	1.69117	0.0844269	10.1223
13	0.92018	1.74226	0.0872272	10.1178
14	0.91668	1.82200	0.0909484	10.1144
15	0.92692	1.87018	0.0921242	10.1121
16	0.92218	1.90013	0.0933690	10.1104
	0.00000	1.92364		

THE REYNOLDS NO. IS 0.24223830E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 19.100 FEET, THE PRESSURE GRADIENT IS 0.0010600 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	12.8826
2	0.48389	0.21542	0.0154927	10.9959
3	0.46759	0.41892	0.0251661	10.6168
4	0.45067	0.61005	0.0342811	10.4540
5	0.43305	0.78940	0.0428171	10.3640
6	0.41465	0.95672	0.0507523	10.3073
7	0.39538	1.11162	0.0580688	10.2688
8	0.37512	1.25386	0.0647604	10.2411
9	0.35369	1.38334	0.0708180	10.2205
10	0.33086	1.49966	0.0762199	10.2049
11	0.30633	1.60237	0.0809417	10.1930
12	0.27965	1.69093	0.0849569	10.1839
13	0.25013	1.76486	0.0882575	10.1771
14	0.21661	1.82445	0.0908484	10.1721
15	0.17685	1.86952	0.0927242	10.1686
16	0.12502	1.89940	0.0933690	10.1660
	0.00000	1.92288		

THE RENOLDS NO. IS 0.54352005E 03 .

THE REMOVAL NO. IS 0.24325002E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.92588	0.0933600	10.1680
2	0.15205	1.89340	0.0951545	10.1689
3	0.17685	1.86325	0.0908484	10.1751
4	0.21661	1.82442	0.0815212	10.1771
5	0.25203	1.76486	0.0749269	10.1839
6	0.27903	1.69903	0.0849269	10.1939
7	0.32512	1.52386	0.0647604	10.2411
8	0.39238	1.11162	0.0580688	10.2688
9	0.41462	0.92612	0.0507253	10.3073
10	0.43302	0.70940	0.0458171	10.3640
11	0.45067	0.61002	0.0345811	10.4240
12	0.46729	0.41842	0.0521661	10.6169
13	0.48389	0.21242	0.0164927	10.9929
14	0.50000	0.00000	0.0025729	12.8826

AT 10.100 FEET, THE PRESSURE GRADIENT IS 0.0010600 LB/IN<sup>2</sup> IN/FT.

THE INCREMENT NUMBER IN LENGTH IS 16 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 25.500 FEET, THE PRESSURE GRADIENT IS 0.0010564 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	13.8454
	0.48404	0.21754		
2			0.0154927	11.3278
	0.46783	0.41971		
3			0.0251661	10.8225
	0.45094	0.61024		
4			0.0342811	10.6056
	0.43333	0.78909		
5			0.0428171	10.4857
	0.41494	0.95597		
6			0.0507523	10.4102
	0.39567	1.11049		
7			0.0580688	10.3587
	0.37540	1.25240		
8			0.0647604	10.3218
	0.35395	1.38155		
9			0.0708180	10.2944
	0.33112	1.49755		
10			0.0762199	10.2736
	0.30657	1.59995		
11			0.0809417	10.2577
	0.27987	1.68822		
12			0.0849569	10.2456
	0.25032	1.76187		
13			0.0882575	10.2365
	0.21677	1.82126		
14			0.0908484	10.2298
	0.17697	1.86616		
15			0.0927242	10.2252
	0.12507	1.89597		
16			0.0933690	10.2217
	0.00000	1.91946		

THE RENOLDS NO. IS 0.54538569E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17.

AT 22.200 FEET, THE PRESSURE GRADIENT IS 0.0010264 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	13.8424
2	0.40000	0.21224	0.0124927	11.3278
3	0.60000	0.41971	0.0251961	10.8522
4	0.80000	0.61024	0.0342811	10.6026
5	1.00000	0.78909	0.0428171	10.4827
6	1.20000	0.92227	0.0502523	10.4102
7	1.40000	1.11049	0.0560988	10.3287
8	1.60000	1.25240	0.0604204	10.2318
9	1.80000	1.38122	0.0700180	10.1244
10	2.00000	1.49222	0.0762199	10.0236
11	2.20000	1.59992	0.0800417	10.0277
12	2.40000	1.68822	0.0849269	10.0426
13	2.60000	1.76187	0.0892212	10.0362
14	2.80000	1.82129	0.0905484	10.0238
15	3.00000	1.86816	0.0925242	10.0222
16	3.20000	1.92227	0.0933990	10.0217

THE RESULTS NO. 12 0.24238266 03.

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0010491 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	15.7302
2	0.48438	0.22252	0.0154927	11.9887
3	0.46838	0.42119	0.0251661	11.2350
4	0.45153	0.61041	0.0342811	10.9099
5	0.43394	0.78825	0.0428171	10.7299
6	0.41555	0.95426	0.0507523	10.6165
7	0.39627	1.10803	0.0580688	10.5393
8	0.37598	1.24928	0.0647604	10.4838
9	0.35452	1.37777	0.0708180	10.4426
10	0.33165	1.49314	0.0762199	10.4114
11	0.30707	1.59492	0.0809417	10.3876
12	0.28032	1.68259	0.0849569	10.3694
13	0.25072	1.75569	0.0882575	10.3556
14	0.21710	1.81465	0.0908484	10.3455
15	0.17720	1.85924	0.0927242	10.3386
16	0.12516	1.88890	0.0933690	10.3335
	0.00000	1.91240		

THE RENOLDS NO. IS 0.54920006E 03 .



THE REYNOLDS NO. IS 0.245000E 03 .

RADIAL INCREMENT NO.	RADIUS (FEET)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.01540	0.0033690	10.3332
2	0.12516	1.88890	0.0051545	10.3386
3	0.11750	1.82954	0.00848484	10.3452
4	0.51710	1.81462	0.0085252	10.3522
5	0.52072	1.72299	0.0049299	10.3694
6	0.58032	1.68529	0.00899412	10.3876
7	0.30707	1.29492	0.00185199	10.4114
8	0.33182	1.40314	0.00708180	10.4426
9	0.32422	1.37717	0.0041904	10.4638
10	0.37298	1.24928	0.00290988	10.5393
11	0.39627	1.10803	0.00207223	10.6122
12	0.41222	0.92426	0.00428171	10.7299
13	0.43394	0.78822	0.00342811	10.9099
14	0.42123	0.61041	0.0021921	11.2320
15	0.46838	0.42119	0.00124927	11.9887
16	0.48438	0.22222	0.00227229	12.7302
17	0.50000	0.00000	0.00227229	12.7302

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.001941 LBS/ INCH.

THE INCREMENT NUMBER IN LENGTH IS 16 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 51.100 FEET, THE PRESSURE GRADIENT IS 0.0010440 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	17.5623
	0.48458	0.22488		
2			0.0154927	12.6404
	0.46867	0.42150		
3			0.0251661	11.6453
	0.45184	0.61021		
4			0.0342811	11.2133
	0.43425	0.78770		
5			0.0428171	10.9738
	0.41586	0.95340		
6			0.0507523	10.8228
	0.39659	1.10690		
7			0.0580688	10.7198
	0.37630	1.24787		
8			0.0647604	10.6459
	0.35483	1.37606		
9			0.0708180	10.5910
	0.33196	1.49109		
10			0.0762199	10.5494
	0.30737	1.59254		
11			0.0809417	10.5176
	0.28061	1.67987		
12			0.0849569	10.4933
	0.25100	1.75264		
13			0.0882575	10.4750
	0.21736	1.81135		
14			0.0908484	10.4616
	0.17745	1.85577		
15			0.0927242	10.4524
	0.12541	1.88538		
16			0.0933690	10.4454
	0.00000	1.90900		

THE RENOLDS NO. IS 0.55185488E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 21.100 FEET, THE PRESSURE GRADIENT IS 0.0010440 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	17.2523
2	0.48428	0.25488	0.0124927	12.6404
3	0.46867	0.45120	0.0221661	11.6423
4	0.42184	0.61021	0.0345811	11.2133
5	0.43452	0.78770	0.0428171	10.9738
6	0.41286	0.92340	0.0207253	10.8258
7	0.37629	1.10690	0.0280688	10.7198
8	0.37630	1.24787	0.0647604	10.6429
9	0.32483	1.37606	0.0708180	10.2910
10	0.33196	1.49109	0.0762199	10.2434
11	0.30737	1.29224	0.0809417	10.2176
12	0.28061	1.67997	0.0849269	10.4933
13	0.22100	1.72764	0.0845272	10.4720
14	0.21732	1.81132	0.0908484	10.4619
15	0.17742	1.82277	0.0927242	10.4224
16	0.12241	1.88238	0.0933390	10.4424
	0.00000	1.90900		

THE REYNOLDS NO. IS 0.22182482E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0010403 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	21.2807
2	0.48446	0.22289	0.0154927	13.9615
3	0.46842	0.41959	0.0251661	12.4738
4	0.45152	0.60972	0.0342811	11.8236
5	0.43391	0.78833	0.0428171	11.4633
6	0.41552	0.95492	0.0507523	11.2362
7	0.39626	1.10919	0.0580688	11.0814
8	0.37599	1.25075	0.0647604	10.9703
9	0.35454	1.37932	0.0708180	10.8878
10	0.33170	1.49457	0.0762199	10.8253
11	0.30714	1.59608	0.0809417	10.7776
12	0.28041	1.68336	0.0849569	10.7412
13	0.25083	1.75600	0.0882575	10.7138
14	0.21723	1.81460	0.0908484	10.6936
15	0.17735	1.85894	0.0927242	10.6798
16	0.12536	1.88858	0.0933690	10.6693
	0.00000	1.91238		

THE RENOLDS NO. IS 0.55380732E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0010403 LBVS INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	0.00000	0.0000000	51.5807
2	0.48446	0.55589	0.0154957	13.9415
3	0.46845	0.41959	0.0521661	15.4738
4	0.45155	0.60975	0.0345811	11.8536
5	0.43391	0.78837	0.0458171	11.4633
6	0.41555	0.95495	0.0507553	11.5365
7	0.39656	1.10919	0.0580688	11.0814
8	0.37699	1.25075	0.0647604	10.9703
9	0.35684	1.37935	0.0708180	10.8878
10	0.33610	1.49457	0.0755199	10.8553
11	0.30714	1.59608	0.0809477	10.7779
12	0.28041	1.68339	0.0849569	10.7415
13	0.25083	1.75600	0.0885575	10.7134
14	0.21753	1.81460	0.0908484	10.6939
15	0.17737	1.85894	0.0927545	10.6798
16	0.15236	1.88958	0.0933690	10.6693
	0.00000	1.91538		

THE RADIUS NO. IS 0.25390756 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 102.300 FEET, THE PRESSURE GRADIENT IS 0.0010347 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	24.9241
2	0.48461	0.22530	0.0154927	15.2713
3	0.46861	0.41726	0.0251661	13.2996
4	0.45165	0.60737	0.0342811	12.4323
5	0.43400	0.78642	0.0428171	11.9517
6	0.41559	0.95350	0.0507523	11.6487
7	0.39631	1.10823	0.0580688	11.4422
8	0.37604	1.25004	0.0647604	11.2941
9	0.35460	1.37870	0.0708180	11.1842
10	0.33175	1.49392	0.0762199	11.1009
11	0.30719	1.59530	0.0809417	11.0374
12	0.28046	1.68235	0.0849569	10.9889
13	0.25087	1.75472	0.0882575	10.9524
14	0.21726	1.81310	0.0908484	10.9256
15	0.17736	1.85729	0.0927242	10.9072
16	0.12533	1.88690	0.0933690	10.8932
	0.00000	1.91084		

THE RENOLDS NO. IS 0.55685342E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 51 .

AT 105.300 FEET, THE PRESSURE GRADIENT IS 0.0010347 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	54.9241
2	0.48461	0.25230	0.0124927	12.2713
3	0.46861	0.41756	0.0251661	13.2996
4	0.42162	0.60737	0.0345811	12.4323
5	0.43400	0.78642	0.0458171	11.9217
6	0.41229	0.92320	0.0207253	11.6487
7	0.79631	1.10823	0.0280288	11.4422
8	0.37604	1.22004	0.0647204	11.2341
9	0.32460	1.37870	0.0708180	11.1642
10	0.33172	1.44392	0.0712519	11.1009
11	0.30719	1.22230	0.0809417	11.0374
12	0.28048	1.68232	0.0849289	10.9899
13	0.22097	1.72472	0.0822272	10.9224
14	0.21726	1.81310	0.0908484	10.9226
15	0.17736	1.82729	0.0927242	10.9072
16	0.12233	1.88690	0.0933990	10.8932
	0.00000	1.91084		

THE REYNOLDS NO. IS 0.22682342E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 22 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.0010238 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	31.9063
2	0.48519	0.23365	0.0154927	17.8786
3	0.46935	0.41260	0.0251661	14.9684
4	0.45223	0.60153	0.0342811	13.6575
5	0.43445	0.78132	0.0428171	12.9323
6	0.41596	0.94957	0.0507523	12.4758
7	0.39664	1.10545	0.0580688	12.1651
8	0.37634	1.24797	0.0647604	11.9426
9	0.35488	1.37700	0.0708180	11.7776
10	0.33203	1.49233	0.0762199	11.6528
11	0.30746	1.59358	0.0809417	11.5576
12	0.28073	1.68029	0.0849569	11.4852
13	0.25113	1.75226	0.0882575	11.4305
14	0.21750	1.81035	0.0908484	11.3904
15	0.17758	1.85435	0.0927242	11.3627
16	0.12555	1.88398	0.0933690	11.3417
	0.00000	1.90830		

THE RENOLDS NO. IS 0.56276017E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 55 .

AT 123.500 FEET, THE PRESSURE GRADIENT IS 0.0010538 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	31.9083
2	0.48219	0.23369	0.0124951	17.8789
3	0.46932	0.41580	0.0521691	14.9584
4	0.42523	0.60123	0.0345811	13.6225
5	0.43442	0.78132	0.0458171	12.9323
6	0.41296	0.94921	0.0501253	12.4128
7	0.36664	1.10242	0.0280288	12.1221
8	0.37634	1.24791	0.0647604	11.9426
9	0.32488	1.37700	0.0708180	11.7712
10	0.33203	1.46533	0.0765199	11.6229
11	0.30746	1.29328	0.0809412	11.2276
12	0.28073	1.60029	0.0643269	11.4822
13	0.22113	1.72226	0.0852212	11.4302
14	0.21720	1.81692	0.0608484	11.3604
15	0.17728	1.82432	0.0625242	11.3621
16	0.12222	1.88328	0.0633690	11.3412
17	0.00000	1.90830		

THE REYNOLDS NO. IS 0.26276012E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 23 .

AT 204.700 FEET, THE PRESSURE GRADIENT IS 0.0010117 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	38.5500
2	0.48575	0.24262	0.0154927	20.4529
3	0.47022	0.41309	0.0251661	16.6512
4	0.45306	0.59710	0.0342811	14.8927
5	0.43519	0.77613	0.0428171	13.9187
6	0.41662	0.94480	0.0507523	13.3062
7	0.39724	1.10123	0.0580688	12.8899
8	0.37690	1.24399	0.0647604	12.5924
9	0.35542	1.37304	0.0708180	12.3721
10	0.33253	1.48819	0.0762199	12.2056
11	0.30794	1.58908	0.0809417	12.0787
12	0.28116	1.67525	0.0849569	11.9822
13	0.25152	1.74671	0.0882575	11.9095
14	0.21784	1.80443	0.0908484	11.8560
15	0.17785	1.84818	0.0927242	11.8192
16	0.12572	1.87781	0.0933690	11.7910
	0.00000	1.90243		

THE RENOLDS NO. IS 0.56946791E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 53 .

AT 504.700 FEET, THE PRESSURE GRADIENT IS 0.0010117 LBX29 INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025299	38.5500
2	0.48212	0.24585	0.0124937	50.4559
3	0.47058	0.41309	0.0251681	16.9215
4	0.45306	0.59710	0.0345811	14.8957
5	0.43219	0.77613	0.0458171	13.9187
6	0.41665	0.94480	0.0502523	13.3025
7	0.39754	1.10153	0.0580886	15.8999
8	0.37690	1.24399	0.0647904	15.5954
9	0.35245	1.37304	0.0709180	15.3751
10	0.33523	1.48619	0.0765197	15.5059
11	0.30794	1.58908	0.0809417	15.0787
12	0.29116	1.67252	0.0849999	11.9855
13	0.25125	1.74671	0.0885275	11.9092
14	0.21784	1.80443	0.0908484	11.8990
15	0.17785	1.84818	0.0925245	11.8195
16	0.15275	1.87791	0.0933990	11.7910
	0.00000	1.90543		

THE REYNOLDS NO. IS 0.59492916 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.0009903 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	51.3609
	0.48612	0.24887		
2			0.0154927	25.4676
	0.47103	0.42419		
3			0.0251661	19.9953
	0.45411	0.59651		
4			0.0342811	17.3766
	0.43620	0.77150		
5			0.0428171	15.9027
	0.41757	0.94002		
6			0.0507523	14.9746
	0.39814	1.09644		
7			0.0580688	14.3456
	0.37776	1.23910		
8			0.0647604	13.8970
	0.35624	1.36786		
9			0.0708180	13.5655
	0.33332	1.48249		
10			0.0762199	13.3154
	0.30868	1.58261		
11			0.0809417	13.1252
	0.28186	1.66772		
12			0.0849569	12.9808
	0.25215	1.73833		
13			0.0882575	12.8719
	0.21839	1.79547		
14			0.0908484	12.7917
	0.17830	1.83886		
15			0.0927242	12.7364
	0.12604	1.86852		
16			0.0933690	12.6934
	0.00000	1.89377		

THE RENOLDS NO. IS 0.58178391E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 54 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.000903 LBS/INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.002525	51.300
2	0.48815	0.54887	0.012452	52.487
3	0.47103	0.45419	0.025161	19.953
4	0.45411	0.29821	0.034581	11.316
5	0.43650	0.17150	0.045817	12.905
6	0.41757	0.94005	0.020753	14.914
7	0.39814	1.09444	0.028088	14.345
8	0.37776	1.53910	0.047604	13.897
9	0.35654	1.39786	0.070818	13.555
10	0.33335	1.48549	0.075219	14.314
11	0.30898	1.58591	0.030947	13.755
12	0.28186	1.66775	0.084959	15.988
13	0.25215	1.73933	0.098525	15.879
14	0.21839	1.79547	0.030848	15.197
15	0.17850	1.83886	0.095254	15.394
16	0.15204	1.86825	0.093990	15.634
	0.00000	1.89377		

THE REYNOLDS NO. IS 0.2815934E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 409.500 FEET, THE PRESSURE GRADIENT IS 0.0009671 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	64.0519
	0.48615	0.24944		
2			0.0154927	30.3895
	0.47128	0.43437		
3			0.0251661	23.2903
	0.45471	0.60690		
4			0.0342811	19.8537
	0.43703	0.77607		
5			0.0428171	17.8899
	0.41848	0.94145		
6			0.0507523	16.6473
	0.39909	1.09513		
7			0.0580688	15.8058
	0.37872	1.23573		
8			0.0647604	15.2062
	0.35717	1.36275		
9			0.0708180	14.7636
	0.33421	1.47570		
10			0.0762199	14.4302
	0.30950	1.57411		
11			0.0809417	14.1769
	0.28259	1.65744		
12			0.0849569	13.9848
	0.25275	1.72687		
13			0.0882575	13.8399
	0.21881	1.78313		
14			0.0908484	13.7330
	0.17850	1.82592		
15			0.0927242	13.6590
	0.12585	1.85541		
16			0.0933690	13.6008
	0.00000	1.88096		

THE RENOLDS NO. IS 0.59572320E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 400.000 FEET, THE PRESSURE GRADIENT IS 0.000371 LB/IN<sup>2</sup> INFL.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025259	64.0219
2	0.48612	0.24944	0.0124927	30.3892
3	0.47128	0.43437	0.021681	23.2303
4	0.45471	0.60990	0.0345811	19.0237
5	0.43703	0.77607	0.0458171	17.8899
6	0.41848	0.94142	0.0507253	18.6473
7	0.39909	1.09213	0.0580288	12.8028
8	0.37872	1.23273	0.0647804	12.5082
9	0.35717	1.36572	0.0708180	14.7639
10	0.33421	1.47270	0.0765199	14.4302
11	0.30920	1.57411	0.0804417	14.1769
12	0.28229	1.67144	0.0844299	13.9843
13	0.25272	1.75987	0.0882572	13.8399
14	0.21881	1.78313	0.0908464	13.7330
15	0.17820	1.82292	0.0925242	13.6290
16	0.12282	1.82241	0.0933290	13.5008
	0.00000	1.88096		

THE REYNOLDS NO. IS 0.2925230E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 26 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.0009305 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	89.9287
2	0.48607	0.24802	0.0154927	40.1509
3	0.47133	0.44285	0.0251661	29.7119
4	0.45513	0.62080	0.0342811	24.7007
5	0.43785	0.79066	0.0428171	21.8160
6	0.41961	0.94997	0.0507523	19.9758
7	0.40039	1.09805	0.0580688	18.7240
8	0.38011	1.23460	0.0647604	17.8292
9	0.35861	1.35837	0.0708180	17.1682
10	0.33565	1.46846	0.0762199	16.6705
11	0.31093	1.56406	0.0809417	16.2932
12	0.28396	1.64487	0.0849569	16.0070
13	0.25404	1.71293	0.0882575	15.7902
14	0.22001	1.76831	0.0908484	15.6299
15	0.17960	1.81064	0.0927242	15.5186
16	0.12689	1.84022	0.0933690	15.4293
	0.00000	1.86702		

THE RENOLDS NO. IS 0.61917471E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.000302 LB/IN<sup>2</sup> INVT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	89.9587
2	0.40007	0.24805	0.0124957	40.1509
3	0.61337	0.44582	0.0251061	29.7119
4	0.82513	0.65080	0.0345811	24.7001
5	0.93782	0.79092	0.0458171	21.8190
6	0.94991	0.94997	0.0507253	19.9258
7	0.96039	1.09802	0.0580899	18.7540
8	0.98011	1.23440	0.0647604	17.8295
9	0.98891	1.32837	0.0708180	17.1985
10	0.99262	1.44846	0.0765199	16.6505
11	0.99033	1.59406	0.0809413	16.2935
12	0.98399	1.66487	0.0849299	16.0070
13	0.97404	1.71593	0.0885252	15.7905
14	0.95001	1.79831	0.0908484	15.6599
15	0.91990	1.81094	0.0925245	15.5189
16	0.95999	1.84055	0.0933690	15.4593
	0.00000	1.89705		

THE REYNOLDS NO. IS 0.619747E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 27 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0009075 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	115.8422
2	0.48607	0.24798	0.0154927	49.8552
3	0.47132	0.44310	0.0251661	36.0758
4	0.45517	0.62437	0.0342811	29.5052
5	0.43798	0.79404	0.0428171	25.7169
6	0.41981	0.95266	0.0507523	23.2946
7	0.40064	1.09993	0.0580688	21.6403
8	0.38039	1.23522	0.0647604	20.4547
9	0.35891	1.35777	0.0708180	19.5781
10	0.33596	1.46672	0.0762199	18.9182
11	0.31123	1.56111	0.0809417	18.4185
12	0.28423	1.64129	0.0849569	18.0387
13	0.25428	1.70929	0.0882575	17.7499
14	0.22022	1.76483	0.0908484	17.5360
15	0.17977	1.80739	0.0927242	17.3868
16	0.12703	1.83731	0.0933690	17.2650
	0.00000	1.86515		

THE RENOLDS NO. IS 0.63488993E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 57 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0009075 LB/20 IN/FT.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	112.8455
2	0.48807	0.24798	0.0124957	49.8255
3	0.47135	0.44310	0.0521661	36.0758
4	0.45217	0.65437	0.0345811	59.2025
5	0.43798	0.79404	0.0458171	52.7189
6	0.41931	0.92566	0.0707253	53.5949
7	0.40064	1.09993	0.0580088	51.6403
8	0.38039	1.23255	0.0647604	50.4247
9	0.35891	1.32777	0.0708180	49.2781
10	0.33736	1.46675	0.0745199	48.9185
11	0.31157	1.56111	0.0809477	48.4182
12	0.28453	1.64159	0.0849299	48.0387
13	0.25458	1.70929	0.0885272	47.7497
14	0.22025	1.76487	0.0909484	47.5320
15	0.17977	1.80739	0.0925745	47.3828
16	0.15703	1.83731	0.0933990	47.2929
	0.00000	1.86715		

THE REYNOLDS NO. IS 0.63489933 OR .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 28 .

AT 1228.700 FEET, THE PRESSURE GRADIENT IS 0.0008781 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	167.4023
2	0.48609	0.24840	0.0154927	69.2576
3	0.47139	0.44447	0.0251661	48.8113
4	0.45530	0.62564	0.0342811	39.1226
5	0.43812	0.79344	0.0428171	33.5339
6	0.41994	0.95087	0.0507523	29.9419
7	0.40075	1.09754	0.0580688	27.4806
8	0.38046	1.23257	0.0647604	25.7131
9	0.35894	1.35499	0.0708180	24.4045
10	0.33595	1.46380	0.0762199	23.4200
11	0.31116	1.55804	0.0809417	22.6738
12	0.28411	1.63939	0.0849569	22.1036
13	0.25413	1.70876	0.0882575	21.6680
14	0.22005	1.76568	0.0908484	21.3446
15	0.17961	1.80941	0.0927242	21.1177
16	0.12690	1.84092	0.0933690	20.9276
	0.00000	1.87072		

THE RENOLDS NO. IS 0.65615772E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 58 .

AT 1558.700 FEET, THE PRESSURE GRADIENT IS 0.0008781 LBS/IN<sup>2</sup> INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025759	167.4053
2	0.48809	0.24840	0.0124357	69.2576
3	0.47139	0.44447	0.0521661	48.8113
4	0.45230	0.65264	0.0345811	39.1556
5	0.43915	0.79344	0.0458171	33.2333
6	0.41994	0.92087	0.0507553	29.9419
7	0.40075	1.00124	0.0580688	27.4806
8	0.38046	1.23257	0.0647604	25.7131
9	0.35894	1.32499	0.0708180	24.4045
10	0.33295	1.46380	0.0765199	23.4500
11	0.31116	1.52804	0.0809417	22.9138
12	0.28411	1.63339	0.0849269	22.1039
13	0.25413	1.70876	0.0905252	21.6680
14	0.22006	1.76268	0.0968484	21.3446
15	0.17961	1.80941	0.0957545	21.1177
16	0.15890	1.84095	0.0937690	20.9579
	0.00000	1.87075		

THE REYNOLDS NO. IS 0.6261575E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 29 .

AT 1638.300 FEET, THE PRESSURE GRADIENT IS 0.0008565 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	218.9524
	0.48615	0.24952		
2			0.0154927	88.5185
	0.47154	0.44685		
3			0.0251661	61.4208
	0.45554	0.62813		
4			0.0342811	48.6664
	0.43844	0.79528		
5			0.0428171	41.3201
	0.42030	0.94985		
6			0.0507523	36.5875
	0.40109	1.09402		
7			0.0580688	33.3308
	0.38076	1.22764		
8			0.0647604	30.9848
	0.35917	1.34948		
9			0.0708180	29.2450
	0.33611	1.45837		
10			0.0762199	27.9355
	0.31126	1.55350		
11			0.0809417	26.9404
	0.28417	1.63653		
12			0.0849569	26.1764
	0.25416	1.70745		
13			0.0882575	25.5911
	0.22009	1.76576		
14			0.0908484	25.1558
	0.17969	1.81065		
15			0.0927242	24.8487
	0.12711	1.84382		
16			0.0933690	24.5860
	0.00000	1.87571		

THE RENOLDS NO. IS 0.67269129E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 1638.300 FEET, THE PRESSURE GRADIENT IS 0.0008252 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	518.9254
2	0.40015	0.24925	0.0124925	48.5182
3	0.47124	0.44682	0.0251681	61.4509
4	0.42224	0.62813	0.0342811	48.6694
5	0.43844	0.73258	0.0428151	41.3201
6	0.45030	0.94982	0.0507253	36.2872
7	0.40103	1.09402	0.0280888	33.3308
8	0.38076	1.22764	0.0647604	30.9848
9	0.32917	1.34948	0.0708180	29.2420
10	0.33611	1.42835	0.0762199	27.9322
11	0.31126	1.22320	0.0809415	26.9404
12	0.28415	1.63623	0.0849299	26.1564
13	0.22419	1.70542	0.0882252	22.2911
14	0.22009	1.76256	0.0908484	22.1228
15	0.17999	1.81092	0.0925242	24.8485
16	0.12711	1.84382	0.0933990	24.2690
	0.00000	1.85251		

THE REYNOLDS NO. IS 0.67292126 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 2457.500 FEET, THE PRESSURE GRADIENT IS 0.0008222 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	321.2860
2	0.48625	0.25133	0.0154927	126.9181
3	0.47168	0.44668	0.0251661	86.6102
4	0.45569	0.62936	0.0342811	67.7317
5	0.43863	0.79674	0.0428171	56.8954
6	0.42052	0.95090	0.0507523	49.9108
7	0.40131	1.09301	0.0580688	45.0800
8	0.38094	1.22366	0.0647604	41.5830
9	0.35927	1.34307	0.0708180	38.9781
10	0.33610	1.45125	0.0762199	37.0071
11	0.31113	1.54793	0.0809417	35.4999
12	0.28394	1.63287	0.0849569	34.3367
13	0.25384	1.70567	0.0882575	33.4432
14	0.21970	1.76573	0.0908484	32.7778
15	0.17922	1.81206	0.0927242	32.3036
16	0.12652	1.84783	0.0933690	31.8837
	0.00000	1.88272		

THE RENOLDS NO. IS 0.70075740E 03 .



THE REYNOLDS NO. IS 0.70075740E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025729	351.5880
2	0.48852	0.52133	0.0124357	152.2181
3	0.47168	0.44668	0.0251661	86.6105
4	0.45269	0.35230	0.0345811	67.1317
5	0.43863	0.26674	0.0458171	52.8054
6	0.42025	0.19020	0.0507553	49.2108
7	0.40131	1.09301	0.0280688	42.0800
8	0.38094	1.55366	0.0047804	41.2830
9	0.35957	1.34307	0.0708180	38.2781
10	0.33610	1.42152	0.0725129	37.0071
11	0.31113	1.24763	0.0809417	32.4499
12	0.28304	1.63587	0.0849269	34.3367
13	0.25384	1.70267	0.0985272	33.4435
14	0.21870	1.76273	0.0908484	35.7778
15	0.17955	1.81506	0.0957745	35.3036
16	0.15625	1.84783	0.0433690	37.8837
	0.00000	1.88575		

AT 2427.200 FEET, THE PRESSURE GRADIENT IS 0.000855 LBS/2 INCH.

THE INCREMENT NUMBER IN LENGTH IS 30 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.0007982 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	423.1238
2	0.48626	0.25138	0.0154927	165.4138
3	0.47161	0.44332	0.0251661	111.8873
4	0.45552	0.62733	0.0342811	86.8118
5	0.43841	0.79627	0.0428171	72.4699
6	0.42028	0.95136	0.0507523	63.2322
7	0.40107	1.09388	0.0580688	56.8365
8	0.38070	1.22473	0.0647604	52.1961
9	0.35903	1.34445	0.0708180	48.7270
10	0.33586	1.45317	0.0762199	46.0893
11	0.31090	1.55063	0.0809417	44.0620
12	0.28373	1.63652	0.0849569	42.4922
13	0.25369	1.71040	0.0882575	41.2842
14	0.21962	1.77159	0.0908484	40.3838
15	0.17928	1.81896	0.0927242	39.7361
16	0.12686	1.85682	0.0933690	39.1471
	0.00000	1.89456		

THE RENOLDS NO. IS 0.72184969E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.0007985 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	453.1538
2	0.48656	0.25139	0.0124957	162.4138
3	0.47161	0.44335	0.0521661	111.8873
4	0.42225	0.65733	0.0345811	86.8118
5	0.43841	0.76657	0.0458171	75.4699
6	0.45058	0.92136	0.0507253	63.5355
7	0.40107	1.04398	0.0580688	56.9362
8	0.38070	1.25473	0.0647304	52.1961
9	0.32903	1.34442	0.0708180	48.7570
10	0.33286	1.42317	0.0745199	46.0893
11	0.31090	1.22093	0.0809417	44.0950
12	0.28373	1.43625	0.0849269	45.4955
13	0.25398	1.71040	0.0885272	41.5645
14	0.21925	1.77159	0.0909494	40.3838
15	0.17958	1.81899	0.0957545	39.7321
16	0.15669	1.82687	0.0933990	39.1471
	0.00000	1.89420		

THE REYNOLDS NO. IS 0.75184999E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 32 .

AT 4915.100 FEET, THE PRESSURE GRADIENT IS 0.0007633 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	624.3120
2	0.48649	0.25554	0.0154927	242.6097
3	0.47191	0.44076	0.0251661	162.9296
4	0.45570	0.62162	0.0342811	125.2305
5	0.43846	0.79129	0.0428171	103.7339
6	0.42024	0.94781	0.0507523	89.9208
7	0.40097	1.09153	0.0580688	80.3567
8	0.38055	1.22314	0.0647604	73.4080
9	0.35884	1.34311	0.0708180	68.2006
10	0.33563	1.45186	0.0762199	64.2266
11	0.31064	1.54945	0.0809417	61.1587
12	0.28342	1.63563	0.0849569	58.7737
13	0.25332	1.71005	0.0882575	56.9329
14	0.21919	1.77199	0.0908484	55.5586
15	0.17876	1.82023	0.0927242	54.5522
16	0.12622	1.86181	0.0933690	53.5989
	0.00000	1.90290		

THE RENOLDS NO. IS 0.75479017E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 4012.100 FEET, THE PRESSURE GRADIENT IS 0.0001833 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	854.3150
2	0.48849	0.25224	0.0124957	545.6037
3	0.47191	0.44076	0.0521661	165.9539
4	0.42270	0.63165	0.0345811	152.5302
5	0.43846	0.79159	0.0459171	103.7339
6	0.45054	0.94781	0.0507523	89.9509
7	0.40097	1.09123	0.0580688	80.3267
8	0.38092	1.25314	0.0647604	73.4080
9	0.32884	1.34371	0.0708180	68.5006
10	0.33203	1.42186	0.0767519	64.5566
11	0.31064	1.54945	0.0809477	61.1587
12	0.28345	1.63203	0.0849299	58.7737
13	0.25335	1.71002	0.0895272	56.9359
14	0.21919	1.77199	0.0909684	55.5286
15	0.17876	1.85053	0.0921545	54.5255
16	0.15255	1.86181	0.0933990	53.5939
	0.00000	1.90590		

THE REYNOLDS NO. IS 0.12479012 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 33 .

AT 6553.500 FEET, THE PRESSURE GRADIENT IS 0.0007391 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	820.6145
2	0.48667	0.25888	0.0154927	319.0955
3	0.47220	0.44181	0.0251661	214.0996
4	0.45598	0.61909	0.0342811	163.8440
5	0.43865	0.78702	0.0428171	135.1276
6	0.42034	0.94367	0.0507523	116.6906
7	0.40100	1.08802	0.0580688	103.9394
8	0.38052	1.22008	0.0647604	94.6773
9	0.35875	1.34048	0.0708180	87.7267
10	0.33549	1.44988	0.0762199	82.4064
11	0.31045	1.54820	0.0809417	78.2852
12	0.28320	1.63521	0.0849569	75.0737
13	0.25307	1.71047	0.0882575	72.5897
14	0.21892	1.77329	0.0908484	70.7315
15	0.17847	1.82292	0.0927242	69.3474
16	0.12593	1.86756	0.0933690	67.9974
	0.00000	1.91149		

THE RENOLDS NO. IS 0.77948399E 03 .



THE REYNOLDS NO. IS 0.17048399E 03 .

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.01143	0.0033690	61.9934
2	0.15293	1.86726	0.0037545	69.3474
3	0.17847	1.85595	0.0037545	70.7372
4	0.51695	1.77359	0.0088484	70.7372
5	0.52307	1.71047	0.0885252	75.2897
6	0.58350	1.63251	0.0849269	75.0737
7	0.31042	1.54950	0.0809417	78.5825
8	0.38025	1.55008	0.0647604	94.6177
9	0.33249	1.44988	0.0725199	85.4084
10	0.35875	1.34048	0.0708180	87.7527
11	0.45034	0.94367	0.0507253	116.6906
12	0.43862	0.78705	0.0458171	135.1579
13	0.45298	0.61909	0.0345811	163.8440
14	0.47350	0.44181	0.0251661	214.0932
15	0.48667	0.52888	0.0124957	319.0922
16	0.50000	0.00000	0.0052579	850.6142

AT 6523.500 FEET, THE PRESSURE GRADIENT IS 0.0007391 LB/29 IN/FT.

THE INCREMENT NUMBER IN LENGTH IS 33 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 34 .

AT 9830.300 FEET, THE PRESSURE GRADIENT IS 0.0007008 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48650	0.25546	0.0052759	1219.9622
2	0.47220	0.45635	0.0154927	470.6873
3	0.45633	0.62663	0.0251661	314.9324
4	0.43914	0.78900	0.0342811	240.7235
5	0.42084	0.94135	0.0428171	197.9232
6	0.40145	1.08372	0.0507523	170.3327
7	0.38091	1.21522	0.0580688	151.2167
8	0.35909	1.33570	0.0647604	137.3156
9	0.33578	1.44517	0.0708180	126.8602
10	0.31068	1.54359	0.0762199	118.8298
11	0.28337	1.63077	0.0809417	112.5871
12	0.25318	1.70637	0.0849569	107.7088
13	0.21897	1.76980	0.0882575	103.9263
14	0.17848	1.82127	0.0908484	101.0805
15	0.12597	1.87030	0.0927242	98.8985
16	0.00000	1.91861	0.0933690	96.6892

THE RENOLDS NO. IS 0.82213445E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 34 .

AT 9830.300 FEET, THE PRESSURE GRADIENT IS 0.0007008 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	1519.9855
2	0.48820	0.25240	0.0124955	470.6873
3	0.47520	0.42932	0.0221661	314.9354
4	0.45633	0.62663	0.0345811	240.7532
5	0.43914	0.78900	0.0458171	197.9535
6	0.42084	0.94132	0.0507523	170.3351
7	0.40142	1.08375	0.0580688	151.2167
8	0.38091	1.21255	0.0647604	137.3126
9	0.35909	1.33250	0.0708180	126.8605
10	0.33278	1.44217	0.0762199	118.8598
11	0.31060	1.54329	0.0809417	112.2817
12	0.28337	1.63977	0.0849299	107.7079
13	0.25318	1.70837	0.0885252	103.9563
14	0.21897	1.76980	0.0908484	101.0802
15	0.17848	1.82157	0.0925745	98.8882
16	0.15247	1.87030	0.0933940	97.6835
	0.00000	1.91861		

THE REYNOLDS NO. IS 0.85213445E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 13107.100 FEET, THE PRESSURE GRADIENT IS 0.0006633 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	1639.6906
2	0.48600	0.24703	0.0154927	619.6331
3	0.47200	0.48300	0.0251661	412.5905
4	0.45686	0.64694	0.0342811	316.7688
5	0.44007	0.80018	0.0428171	260.6045
6	0.42198	0.94663	0.0507523	224.0945
7	0.40270	1.08398	0.0580688	198.6876
8	0.38218	1.21139	0.0647604	180.1618
9	0.36033	1.32885	0.0708180	166.1980
10	0.33695	1.43610	0.0762199	155.4500
11	0.31176	1.53287	0.0809417	147.0757
12	0.28435	1.61885	0.0849569	140.5186
13	0.25403	1.69361	0.0882575	135.4251
14	0.21966	1.75650	0.0908484	131.5664
15	0.17899	1.80995	0.0927242	128.5321
16	0.12632	1.86192	0.0933690	125.3857
	0.00000	1.91308		

THE RENOLDS NO. IS 0.86855289E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 32 .

AT 13107.100 FEET, THE PRESSURE GRADIENT IS 0.000633 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	1339.9999
2	0.40000	0.24703	0.012495	919.9999
3	0.60000	0.48300	0.032166	415.9999
4	0.80000	0.66994	0.054511	316.9999
5	1.00000	0.80018	0.065811	260.9999
6	1.20000	0.94663	0.070523	244.9999
7	1.40000	1.08398	0.078088	198.9999
8	1.60000	1.21130	0.084704	180.9999
9	1.80000	1.32882	0.090818	162.9999
10	2.00000	1.43610	0.095519	152.9999
11	2.20000	1.53297	0.098917	147.9999
12	2.40000	1.61892	0.099999	140.9999
13	2.60000	1.69361	0.098279	132.9999
14	2.80000	1.75920	0.094984	131.9999
15	3.00000	1.80992	0.089545	128.9999
16	3.20000	1.85195	0.083990	122.9999

THE RADIUS NO. IS 0.0882589E 03 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 36 .

AT 19660.700 FEET, THE PRESSURE GRADIENT IS 0.0006058 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	2541.7301
2	0.48515	0.23190	0.0154927	924.8430
3	0.47008	0.45464	0.0251661	601.5372
4	0.45507	0.69450	0.0342811	461.3803
5	0.43940	0.85065	0.0428171	382.1692
6	0.42218	0.98003	0.0507523	329.9772
7	0.40344	1.10383	0.0580688	293.0526
8	0.38326	1.22132	0.0647604	265.8385
9	0.36161	1.33082	0.0708180	245.1672
10	0.33832	1.43158	0.0762199	229.1561
11	0.31314	1.52304	0.0809417	216.6160
12	0.28566	1.60464	0.0849569	206.7589
13	0.25521	1.67570	0.0882575	199.0834
14	0.22063	1.73572	0.0908484	193.1553
15	0.17970	1.79161	0.0927242	188.2916
16	0.12678	1.84650	0.0933690	183.1433
	0.00000	1.90050		

THE RENOLDS NO. IS 0.95098627E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 19660.700 FEET, THE PRESSURE GRADIENT IS 0.000028 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052529	5241.1301
2	0.48512	0.53190	0.0124957	524.8430
3	0.47008	0.42464	0.0521661	601.2375
4	0.45507	0.69450	0.0345811	461.3803
5	0.43940	0.85062	0.0458171	385.1695
6	0.42518	0.98003	0.0507553	359.9175
7	0.40344	1.10383	0.0580688	593.0256
8	0.38356	1.55135	0.0647604	562.8382
9	0.36161	1.33085	0.0708180	545.1675
10	0.33835	1.43158	0.0765199	559.1561
11	0.31314	1.55304	0.0809417	516.6160
12	0.28566	1.60464	0.0849229	502.7289
13	0.25551	1.67570	0.0885212	199.0834
14	0.25063	1.73275	0.0908484	193.1253
15	0.17970	1.79161	0.0937345	188.5916
16	0.15678	1.84620	0.0933990	183.1433
	0.00000	1.90050		

THE REYNOLDS NR. IS 0.9209857E 03 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 37 .

AT 26214.300 FEET, THE PRESSURE GRADIENT IS 0.0005705 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	3471.2680
2	0.48443	0.22262	0.0154927	1258.3826
3	0.46785	0.40392	0.0251661	798.7952
4	0.45137	0.65939	0.0342811	601.8069
5	0.43543	0.87785	0.0428171	498.2634
6	0.41880	1.03195	0.0507523	431.9800
7	0.40082	1.15359	0.0580688	385.0449
8	0.38126	1.26043	0.0647604	350.1418
9	0.36007	1.36099	0.0708180	323.3640
10	0.33713	1.45473	0.0762199	302.4691
11	0.31220	1.54067	0.0809417	286.0118
12	0.28490	1.61765	0.0849569	273.0292
13	0.25456	1.68468	0.0882575	262.8809
14	0.22004	1.74317	0.0908484	254.8781
15	0.17917	1.80023	0.0927242	248.0978
16	0.12635	1.85623	0.0933690	240.8594
	0.00000	1.91123		

THE RENOLDS NO. IS 0.10098925E 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 37 .

AT 26514.300 FEET, THE PRESSURE GRADIENT IS 0.0002705 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	0.00000	0.0025229	3471.2690
2	0.48443	0.22582	0.0124927	1528.3829
3	0.48782	0.40322	0.0221661	148.1922
4	0.42137	0.62239	0.0342811	901.8069
5	0.43243	0.87782	0.0428171	492.2234
6	0.41880	1.03192	0.0207223	431.9800
7	0.40082	1.12229	0.0280688	382.0449
8	0.38129	1.26043	0.0647904	320.1418
9	0.36007	1.36029	0.0708180	253.3940
10	0.33713	1.42473	0.0762199	302.4991
11	0.31220	1.24097	0.0809417	289.0118
12	0.28490	1.61762	0.0842299	273.0292
13	0.22429	1.68468	0.0982222	292.8809
14	0.22004	1.74317	0.0408484	224.8781
15	0.17917	1.80023	0.0925242	248.0978
16	0.12932	1.82923	0.0933990	240.8294
	0.00000	1.91727		

THE REYNOLDS NO. IS 0.10038922E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 38 .

AT 39321.500 FEET, THE PRESSURE GRADIENT IS 0.0005263 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48334	0.20843	0.0154927	1959.8917
3	0.46638	0.39942	0.0251661	1240.6861
4	0.44810	0.55611	0.0342811	913.9309
5	0.42898	0.75418	0.0428171	736.9441
6	0.41027	0.98923	0.0507523	631.1133
7	0.39173	1.18149	0.0580688	561.2689
8	0.37249	1.32967	0.0647604	511.0515
9	0.35202	1.44814	0.0708180	472.9512
10	0.32995	1.54560	0.0762199	443.3637
11	0.30591	1.62743	0.0809417	420.0828
12	0.27943	1.69679	0.0849569	401.7065
13	0.24984	1.75619	0.0882575	387.1198
14	0.21605	1.81365	0.0908484	375.1672
15	0.17599	1.87033	0.0927242	364.7237
16	0.12418	1.92595	0.0933690	353.5039
	0.00000	1.98063		

THE RENOLDS NO. IS 0.10947392E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 38 .

AT 39351.200 FEET, THE PRESSURE GRADIENT IS 0.0002523 LB/IN<sup>2</sup> INVERT.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CM FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0002523	4000.0000
2	0.48334	0.50843	0.0124357	1929.8917
3	0.48638	0.39945	0.0251661	1540.6861
4	0.44810	0.22611	0.0345811	913.9309
5	0.45898	0.12418	0.0458171	139.9447
6	0.41057	0.08953	0.0505253	631.1133
7	0.39173	1.18149	0.0290688	291.2689
8	0.37549	1.32997	0.0647904	211.0212
9	0.32505	1.44814	0.0708180	415.9215
10	0.35992	1.24260	0.0765199	443.3937
11	0.30291	1.95743	0.0809477	450.0858
12	0.51943	1.99979	0.0842299	407.1022
13	0.54984	1.72619	0.0895272	387.1199
14	0.51902	1.91362	0.0909484	372.1975
15	0.17299	1.97033	0.0951545	364.1537
16	0.15418	1.95292	0.0933990	353.2039
	0.00000	1.98093		

THE REYNOLDS NO. IS 0.10947395E 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 39 .

AT 52428.699 FEET, THE PRESSURE GRADIENT IS 0.0005133 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48299	0.20439	0.0154927	2676.1592
3	0.46567	0.39393	0.0251661	1692.1559
4	0.44761	0.57317	0.0342811	1249.8555
5	0.42837	0.71752	0.0428171	998.8805
6	0.40786	0.87587	0.0507523	842.7629
7	0.38695	1.07550	0.0580688	740.7063
8	0.36604	1.27395	0.0647604	669.7897
9	0.34470	1.44384	0.0708180	617.9813
10	0.32237	1.57847	0.0762199	578.9446
11	0.29844	1.68531	0.0809417	548.8495
12	0.27232	1.76927	0.0849569	525.3493
13	0.24327	1.84034	0.0882575	506.4663
14	0.21022	1.90862	0.0908484	490.5778
15	0.17116	1.97416	0.0927242	476.5180
16	0.12074	2.03696	0.0933690	461.4151
	0.00000	2.09745		

THE RENOLDS NO. IS 0.11224981E 04 .



THE AGE OF FILM IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 39 .

AT 25458.609 FEET, THE PRESSURE GRADIENT IS 0.000213 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRAL OR INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	4000.0000
2	0.48299	0.20439	0.0124927	2576.1292
3	0.46287	0.39393	0.021661	1992.1229
4	0.44761	0.27377	0.0342811	1549.8222
5	0.42837	0.71722	0.0428171	998.8802
6	0.40786	0.87287	0.0207223	842.7624
7	0.38692	1.07220	0.0280888	740.7093
8	0.36604	1.27392	0.0447604	699.7837
9	0.34470	1.44384	0.0708180	617.9813
10	0.32237	1.27847	0.0762799	578.9440
11	0.29844	1.68231	0.0804717	548.8492
12	0.27232	1.79927	0.0949269	222.3493
13	0.24327	1.84034	0.082222	208.4693
14	0.21022	1.40862	0.0908484	490.2718
15	0.17716	1.97416	0.0921242	476.2780
16	0.15074	2.03999	0.0933990	461.4721
	0.00000	2.09742		

THE REYNOLDS NO. IS 0.1122486E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 40 .

AT 78643.099 FEET, THE PRESSURE GRADIENT IS 0.0005180 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48313	0.20611	0.0154927	4000.0000
3	0.46606	0.40103	0.0251661	2557.2172
4	0.44832	0.58495	0.0342811	1882.7854
5	0.42986	0.76007	0.0428171	1528.0941
6	0.41064	0.92405	0.0507523	1296.3970
7	0.39034	1.06038	0.0580688	1129.8494
8	0.36872	1.19188	0.0647604	1008.8677
9	0.34582	1.32973	0.0708180	920.1718
10	0.32175	1.47728	0.0762199	854.2496
11	0.29641	1.61829	0.0809417	804.8380
12	0.26930	1.73915	0.0849569	767.2384
13	0.23965	1.84344	0.0882575	736.9263
14	0.20640	1.94370	0.0908484	711.0485
15	0.16758	2.03974	0.0927242	688.1705
16	0.11804	2.13093	0.0933690	663.9801
	0.00000	2.21803		

THE RENOLDS NO. IS 0.11122801E 04 .

THE RENDOS NO. 12 0.11153801 04 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0055529	4000.0000
2	0.48313	0.50411	0.0124957	4000.0000
3	0.46506	0.40103	0.0251641	5251.5175
4	0.44835	0.28495	0.0345911	1885.7854
5	0.45286	0.75007	0.0458171	1258.0941
6	0.41094	0.95495	0.0507523	1566.3970
7	0.39034	1.06038	0.0280888	1159.8494
8	0.36875	1.19188	0.0647604	1008.8977
9	0.34585	1.35973	0.0708180	950.7118
10	0.35175	1.47758	0.0765199	854.5499
11	0.50941	1.61859	0.0809417	804.8380
12	0.56970	1.73915	0.0849269	767.5384
13	0.53965	1.84344	0.0885275	739.9523
14	0.50640	1.94970	0.0908484	711.0482
15	0.16758	5.03974	0.0957545	689.1102
16	0.11804	5.13093	0.0933990	697.9801
	0.00000	5.51803		

AT 78643.099 FEET, THE PRESSURE GRADIENT IS 0.0002180 LBS/IN INCH.

THE INCREMENT NUMBER IN LENGTH IS 40 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 41 .

AT 104857.498 FEET, THE PRESSURE GRADIENT IS 0.0005109 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48292	0.20343	0.0154927	4000.0000
3	0.46562	0.39655	0.0251661	3448.3989
4	0.44770	0.58111	0.0342811	2535.7289
5	0.42910	0.75547	0.0428171	2048.7968
6	0.40972	0.92136	0.0507523	1735.3852
7	0.38952	1.07911	0.0580688	1513.3710
8	0.36838	1.22688	0.0647604	1350.9555
9	0.34606	1.35604	0.0708180	1229.5218
10	0.32226	1.47804	0.0762199	1136.8609
11	0.29678	1.59831	0.0809417	1066.3125
12	0.26932	1.71626	0.0849569	1012.0950
13	0.23934	1.83046	0.0882575	967.9571
14	0.20588	1.94104	0.0908484	930.0402
15	0.16700	2.04766	0.0927242	896.6232
16	0.11759	2.15002	0.0933690	861.6444
	0.00000	2.24956		

THE RENOLDS NO. IS 0.11278065E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 41 .

AT 104827.498 FEET, THE PRESSURE GRADIENT IS 0.000210 LBS/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025729	4000.0000
2	0.48595	0.50343	0.0124957	4000.0000
3	0.46262	0.39622	0.0221661	3448.3989
4	0.44770	0.28111	0.0342811	2232.7289
5	0.42910	0.22247	0.0458171	2048.7098
6	0.40975	0.25132	0.0507253	1732.3825
7	0.38922	1.07911	0.0780688	1213.3710
8	0.36838	1.22638	0.0647604	1320.2222
9	0.34606	1.32604	0.0708180	1229.2210
10	0.32226	1.47804	0.0762199	1136.8803
11	0.29678	1.29931	0.0809477	1069.3152
12	0.26932	1.71626	0.0849269	1012.0920
13	0.23934	1.83046	0.0892222	967.2211
14	0.20288	1.94104	0.0938484	930.0402
15	0.16100	2.04160	0.0972542	896.6232
16	0.11299	2.12002	0.0993690	867.6444
	0.00000	2.24926		

THE REYNOLDS NO. IS 0.11278022 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 42 .

AT 157286.297 FEET, THE PRESSURE GRADIENT IS 0.0005044 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48271	0.20109	0.0154927	4000.0000
3	0.46519	0.39191	0.0251661	4000.0000
4	0.44707	0.57599	0.0342811	3863.2791
5	0.42832	0.75197	0.0428171	3111.4059
6	0.40883	0.91811	0.0507523	2614.3184
7	0.38851	1.07523	0.0580688	2260.6503
8	0.36724	1.22368	0.0647604	2011.3304
9	0.34487	1.36358	0.0708180	1832.0208
10	0.32120	1.49484	0.0762199	1696.0218
11	0.29594	1.61719	0.0809417	1589.3989
12	0.26868	1.73054	0.0849569	1503.7045
13	0.23883	1.83994	0.0882575	1431.8721
14	0.20544	1.94868	0.0908484	1369.6580
15	0.16662	2.05589	0.0927242	1314.6904
16	0.11729	2.16066	0.0933690	1257.2867
	0.00000	2.26408		

THE RENOLDS NO. IS 0.11423302E 04 .



THE REYNOLDS NO. IS 0.11453305E 04 .

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	2.54408	0.0033900	1521.5821
2	0.11150	2.16066	0.0451545	1314.6904
3	0.16665	2.02289	0.0908484	1399.6780
4	0.20244	1.94898	0.0985252	1431.8151
5	0.23093	1.83994	0.0849289	1503.1042
6	0.26098	1.73024	0.0609417	1589.3980
7	0.29294	1.61719	0.0465199	1699.0518
8	0.32150	1.49484	0.0308190	1835.0508
9	0.34487	1.36928	0.0146104	2011.3304
10	0.36821	1.07253	0.0280888	2560.6203
11	0.40883	0.91811	0.0207253	2614.3184
12	0.45875	0.75197	0.0458171	3111.4023
13	0.44707	0.57299	0.0345011	3863.5791
14	0.46219	0.39191	0.0251681	4600.0000
15	0.48571	0.20109	0.0124957	4000.0000
16	0.50000	0.00000	0.005129	4000.0000

AT 152586.297 FEET, THE PRESSURE GRADIENT IS 0.0005044 LB/IN<sup>2</sup> INVERT.

THE INCREMENT NUMBER IN LENGTH IS 45 .

THE AGE OF FLOW IS 4000.0000 MIN.



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 43 .

AT 209715.096 FEET, THE PRESSURE GRADIENT IS 0.0005030 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	4000.0000
2	0.48266	0.20065	0.0154927	4000.0000
3	0.46510	0.39092	0.0251661	4000.0000
4	0.44692	0.57453	0.0342811	4000.0000
5	0.42812	0.75063	0.0428171	4000.0000
6	0.40862	0.91873	0.0507523	3489.4022
7	0.38832	1.07736	0.0580688	3019.0980
8	0.36709	1.22662	0.0647604	2685.1503
9	0.34477	1.36686	0.0708180	2441.9157
10	0.32115	1.49812	0.0762199	2256.2606
11	0.29594	1.62020	0.0809417	2110.3463
12	0.26874	1.73313	0.0849569	1992.3374
13	0.23894	1.84203	0.0882575	1892.5106
14	0.20559	1.94871	0.0908484	1805.6115
15	0.16678	2.05271	0.0927242	1728.7680
16	0.11739	2.15366	0.0933690	1648.5850
	0.00000	2.25277		

THE RENOLDS NO. IS 0.11455215E 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 43 .

AT 509712.096 FEET, THE PRESSURE GRADIENT IS 0.0002030 LB/20 IN/FT.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	4000.0000
2	0.48566	0.20062	0.0124421	4000.0000
3	0.46210	0.39092	0.0221661	4000.0000
4	0.44692	0.21423	0.0342811	4000.0000
5	0.42812	0.12063	0.0428171	4000.0000
6	0.40862	0.21813	0.0201223	3489.4022
7	0.38832	1.01136	0.0280888	3019.0980
8	0.36109	1.22662	0.0641604	2682.1203
9	0.34412	1.36686	0.0708180	2441.9121
10	0.32112	1.46812	0.0762199	2228.2600
11	0.29294	1.62020	0.0809412	2110.3423
12	0.26814	1.73313	0.0849269	1992.3324
13	0.23894	1.84203	0.0882222	1882.2104
14	0.20229	1.94021	0.0908484	1802.9112
15	0.16678	2.02221	0.0922242	1728.2680
16	0.11239	2.12369	0.0933690	1649.2820
17	0.00000	2.22222		

THE RENGLOS NO. IS 0.11422212 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 44 .

AT 314572.695 FEET, THE PRESSURE GRADIENT IS 0.0005017 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48262	0.20019	0.0052759	4000.0000
2	0.46502	0.39002	0.0154927	4000.0000
3	0.44679	0.57318	0.0251661	4000.0000
4	0.42794	0.74885	0.0342811	4000.0000
5	0.40838	0.91662	0.0428171	4000.0000
6	0.38803	1.07617	0.0507523	4000.0000
7	0.36678	1.22715	0.0580688	4000.0000
8	0.34447	1.36914	0.0647604	4000.0000
9	0.32087	1.50141	0.0708180	3660.3824
10	0.29570	1.62378	0.0762199	3376.8965
11	0.26853	1.73649	0.0809417	3152.5254
12	0.23877	1.84524	0.0849569	2969.4816
13	0.20546	1.95177	0.0882575	2813.7878
14	0.16668	2.05562	0.0908484	2678.3828
15	0.11733	2.15643	0.0927242	2558.9148
16	0.00000	2.25544	0.0933690	2434.6508

THE RENOLDS NO. IS 0.11483747E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 44 .

AT 314575.492 FEET, THE PRESSURE GRADIENT IS 0.0002017 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	4000.0000
2	0.48585	0.25019	0.0124927	4000.0000
3	0.46202	0.39902	0.021991	4000.0000
4	0.44679	0.21318	0.0345811	4000.0000
5	0.45794	0.14882	0.0458171	4000.0000
6	0.40838	0.91665	0.0207253	4000.0000
7	0.38803	1.07617	0.0280968	4000.0000
8	0.36678	1.22112	0.0647804	4000.0000
9	0.34447	1.36974	0.0708180	3660.3824
10	0.32087	1.20141	0.0795199	3378.8922
11	0.29270	1.62378	0.0809417	3125.2524
12	0.26823	1.12649	0.0849289	2969.4816
13	0.23877	1.84254	0.0892572	2813.7878
14	0.20246	1.92177	0.0908484	2678.3928
15	0.16668	2.02262	0.0925242	2528.9168
16	0.11733	2.12643	0.0933930	2434.6209
	0.00000	2.22244		

THE REYNOLDS NO. IS 0.118374E 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 45 .

AT 419430.293 FEET, THE PRESSURE GRADIENT IS 0.0005017 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48262	0.20018	0.0052759	4000.0000
2	0.46501	0.38999	0.0154927	4000.0000
3	0.44679	0.57311	0.0251661	4000.0000
4	0.42793	0.74875	0.0342811	4000.0000
5	0.40837	0.91651	0.0428171	4000.0000
6	0.38802	1.07604	0.0507523	4000.0000
7	0.36677	1.22699	0.0580688	4000.0000
8	0.34445	1.36901	0.0647604	4000.0000
9	0.32086	1.50172	0.0708180	4000.0000
10	0.29570	1.62464	0.0762199	4000.0000
11	0.26855	1.73766	0.0809417	4000.0000
12	0.23881	1.84663	0.0849569	3943.9456
13	0.20554	1.95334	0.0882575	3732.8954
14	0.16682	2.05737	0.0908484	3548.9418
15	0.11758	2.15833	0.0927242	3386.5417
16	0.00000	2.25798	0.0933690	3217.6281

THE RENOLDS NO. IS 0.11485142E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 42 .

AT 419430.293 FEET, THE PRESSURE GRADIENT IS 0.0005017 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.002529	4000.0000
2	0.48262	0.50018	0.012452	4000.0000
3	0.46501	0.38999	0.021661	4000.0000
4	0.44829	0.27311	0.034281	4000.0000
5	0.43293	0.14825	0.045817	4000.0000
6	0.40832	0.01621	0.050252	4000.0000
7	0.38102	1.07604	0.026088	4000.0000
8	0.36222	1.52999	0.064204	4000.0000
9	0.34442	1.36901	0.070818	4000.0000
10	0.32086	1.20125	0.072529	4000.0000
11	0.29220	1.62464	0.080912	4000.0000
12	0.26822	1.22166	0.084089	3943.9420
13	0.23881	1.84663	0.082529	3235.8329
14	0.20224	1.92334	0.090984	3248.9418
15	0.16682	2.02132	0.092524	3386.2412
16	0.11228	2.12933	0.093390	3512.9281
	0.00000	2.22198		

THE RESULTS NO. IS 0.11462142 OF .



THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 46 .

AT 528000.000 FEET, THE PRESSURE GRADIENT IS 0.0005016 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	4000.0000
	0.48262	0.20014		
2			0.0154927	4000.0000
	0.46501	0.38993		
3			0.0251661	4000.0000
	0.44678	0.57304		
4			0.0342811	4000.0000
	0.42792	0.74865		
5			0.0428171	4000.0000
	0.40835	0.91639		
6			0.0507523	4000.0000
	0.38800	1.07589		
7			0.0580688	4000.0000
	0.36674	1.22682		
8			0.0647604	4000.0000
	0.34442	1.36883		
9			0.0708180	4000.0000
	0.32082	1.50151		
10			0.0762199	4000.0000
	0.29566	1.62441		
11			0.0809417	4000.0000
	0.26850	1.73741		
12			0.0849569	4000.0000
	0.23875	1.84639		
13			0.0882575	4000.0000
	0.20546	1.95319		
14			0.0908484	4000.0000
	0.16672	2.05733		
15			0.0927242	4000.0000
	0.11745	2.15846		
16			0.0933690	4000.0000
	0.00000	2.25809		

THE RENOLDS NO. IS 0.11486808E 04 .

THE AGE OF FLOW IS 4000.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 46 .

AT 258000.000 FEET, THE PRESSURE GRADIENT IS 0.0005016 LBS/INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	4000.0000
2	0.48565	0.20014	0.0124453	4000.0000
3	0.44201	0.38993	0.021641	4000.0000
4	0.44638	0.53304	0.0345811	4000.0000
5	0.45195	0.74825	0.0459171	4000.0000
6	0.46832	0.91639	0.0502523	4000.0000
7	0.38800	1.02289	0.0580888	4000.0000
8	0.36634	1.22685	0.0642604	4000.0000
9	0.34445	1.36883	0.0708180	4000.0000
10	0.32085	1.50121	0.0765199	4000.0000
11	0.29266	1.62441	0.0804413	4000.0000
12	0.26820	1.73341	0.0842269	4000.0000
13	0.23832	1.84639	0.0885232	4000.0000
14	0.20246	1.95319	0.0908484	4000.0000
15	0.16635	2.05333	0.0925245	4000.0000
16	0.11345	2.12846	0.0933690	4000.0000
17	0.00000	2.22809		

THE REYNOLDS NO. IS 0.1148808E 04 .



THE AGE OF FLOW IS 4000.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)		PRESSURE (LB/SQ IN)
0.000		0.00000
0.100		0.00011
0.300		0.00032
0.700		0.00075
1.500		0.00160
3.100		0.00330
6.300		0.00671
12.700		0.01350
25.500		0.02707
51.100		0.05393
102.300		0.10718
204.700		0.21200
409.500		0.41476
819.100		0.79683
1638.300		1.51721
3276.700		2.86709
6553.500		5.37418
13107.100		9.96792
26214.300		17.95730
52428.699		31.89005
104857.498		58.94426
209715.096		111.91983
419430.293		217.17788
528000.000		271.63797

WITH 528000.0 FT., THE DROP IN PRESSURE IS 271.6380 LB/SQ IN.

THE PRESSURE IS 271.6380 LB/SQ IN.



THE AGE OF FLOW IS 4000.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LB/IN<sup>2</sup>)

0.0000	0.000
0.0001	0.100
0.0003	0.300
0.0007	0.700
0.0010	1.200
0.0030	3.100
0.0071	8.300
0.0130	15.100
0.0207	22.200
0.0333	31.100
0.1018	102.300
0.2150	204.700
0.4146	409.200
0.7983	818.100
1.2121	1238.300
2.8610	3276.700
5.3749	6227.200
9.9625	13107.100
17.9230	26214.300
31.9905	52428.699
58.9445	104827.498
111.9193	209712.096
217.1788	419430.293
521.9321	258000.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 521.9380 LB/IN<sup>2</sup>

THE AGE OF FLOW IS 0.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 1 .

AT 0.000 FEET, THE PRESSURE GRADIENT IS 0.0030832 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0069455	0.0000
	0.48412	0.27854		
2			0.0198941	0.0000
	0.46771	0.52706		
3			0.0313724	0.0000
	0.45069	0.74636		
4			0.0414445	0.0000
	0.43301	0.93765		
5			0.0501753	0.0000
	0.41458	1.10231		
6			0.0576316	0.0000
	0.39528	1.24167		
7			0.0638808	0.0000
	0.37500	1.35718		
8			0.0690004	0.0000
	0.35355	1.45055		
9			0.0730802	0.0000
	0.33072	1.52374		
10			0.0762217	0.0000
	0.30619	1.57889		
11			0.0785324	0.0000
	0.27951	1.61825		
12			0.0801248	0.0000
	0.25000	1.64412		
13			0.0811105	0.0000
	0.21651	1.65878		
14			0.0816232	0.0000
	0.17678	1.66548		
15			0.0818392	0.0000
	0.12500	1.66791		
16			0.0818733	0.0000
	0.00000	1.66865		

THE RENOLDS NO. IS 0.18687134E 03 .



THE AGE OF FLOW IS 0.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 1 .

AT 0.000 FEET, THE PRESSURE GRADIENT IS 0.003035 LBS/2 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002422	0.0000
2	0.48412	0.21824	0.019841	0.0000
3	0.48711	0.22106	0.0313724	0.0000
4	0.42069	0.14636	0.041442	0.0000
5	0.43301	0.43122	0.0201723	0.0000
6	0.41428	1.10231	0.0216316	0.0000
7	0.39228	1.24167	0.0638808	0.0000
8	0.37200	1.32718	0.0690004	0.0000
9	0.35222	1.42022	0.0730802	0.0000
10	0.33072	1.25374	0.0762217	0.0000
11	0.30619	1.27689	0.0782324	0.0000
12	0.27921	1.61822	0.0801248	0.0000
13	0.22000	1.64412	0.0811102	0.0000
14	0.21621	1.62678	0.0816232	0.0000
15	0.17678	1.66248	0.0818322	0.0000
16	0.12200	1.66791	0.0818133	0.0000
17	0.00000	1.66862		

THE REYNOLDS NO. IS 0.1897134E 03 .



THE AGE OF FLOW IS 0.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)		PRESSURE (LB/SQ IN)
0.000		0.00000
0.100		0.00031
0.300		0.00092
0.700		0.00216
1.500		0.00462
3.100		0.00956
6.300		0.01942
12.700		0.03916
25.500		0.07862
51.100		0.15755
102.300		0.31541
204.700		0.63112
409.500		1.26255
819.100		2.52541
1638.300		5.05113
3276.700		10.10256
6553.500		20.20543
13107.100		40.41117
26214.300		80.82266
52428.699		161.64562
104857.498		323.29155
209715.096		646.58341
419430.293		1293.16713
528000.000		1627.90399

WITH 528000.0 FT., THE DROP IN PRESSURE IS 1627.9040 LB/SQ IN.

THE PRESSURE DROP AS CALCULATED BY

THE AGE OF FLOW IS 0.0000 MIN.

(FEET) DISTANCE FROM ENTRANCE  
PRESSURE (LBS/IN)

0.0000	0.000
0.0001	0.100
0.0002	0.300
0.0005	0.700
0.0010	1.500
0.0020	3.100
0.0050	6.300
0.0100	12.700
0.0200	25.200
0.0500	51.100
0.1000	102.300
0.2000	204.700
0.5000	409.200
1.0000	818.100
2.0000	1638.300
5.0000	3276.700
10.0000	6553.200
20.0000	13107.100
50.0000	26214.300
100.0000	52428.600
200.0000	104857.400
500.0000	262143.000
1000.0000	524286.000
2000.0000	1048572.000
5000.0000	2621430.000
10000.0000	5242860.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 1657.9040 LBS/IN.

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 2.300 FEET, THE PRESSURE GRADIENT IS 0.0010849 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48186	0.19203	0.0052759	10.3586
2	0.46456	0.41271	0.0154927	10.1214
3	0.44744	0.61096	0.0251661	10.0745
4	0.42978	0.79559	0.0342811	10.0547
5	0.41143	0.96731	0.0428171	10.0438
6	0.39225	1.12604	0.0507523	10.0369
7	0.37210	1.27160	0.0580688	10.0323
8	0.35080	1.40405	0.0647604	10.0290
9	0.32814	1.52310	0.0708180	10.0265
10	0.30379	1.62825	0.0762199	10.0246
11	0.27733	1.71903	0.0809417	10.0232
12	0.24805	1.79486	0.0849569	10.0221
13	0.21483	1.85592	0.0882575	10.0212
14	0.17543	1.90208	0.0908484	10.0206
15	0.12410	1.93263	0.0927242	10.0202
16	0.00000	1.95612	0.0933690	10.0199

THE RENOLDS NO. IS 0.53104627E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 2.300 FEET, THE PRESSURE GRADIENT IS 0.0010849 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	10.3286
2	0.41816	0.19203	0.0124927	10.1214
3	0.64628	0.41271	0.0251661	10.0742
4	0.87444	0.61096	0.0342811	10.0247
5	0.42978	0.79229	0.0428171	10.0438
6	0.41143	0.96731	0.0507253	10.0369
7	0.39252	1.12904	0.0580688	10.0323
8	0.37210	1.27160	0.0647904	10.0290
9	0.35080	1.40402	0.0708180	10.0252
10	0.32814	1.52310	0.0762199	10.0242
11	0.30329	1.62922	0.0809417	10.0232
12	0.27733	1.71903	0.0844289	10.0221
13	0.24802	1.79486	0.0862712	10.0212
14	0.21483	1.82292	0.0908484	10.0209
15	0.17247	1.90208	0.0925242	10.0202
16	0.12410	1.93263	0.0933290	10.0194
	0.00000	1.92812		

THE REYNOLDS NO. IS 0.2310457E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11 .

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.0010847 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48188	0.19232	0.0052759	10.5050
2	0.46459	0.41315	0.0154927	10.1656
3	0.44748	0.61142	0.0251661	10.1004
4	0.42983	0.79605	0.0342811	10.0736
5	0.41148	0.96776	0.0428171	10.0589
6	0.39231	1.12650	0.0507523	10.0496
7	0.37217	1.27206	0.0580688	10.0434
8	0.35089	1.40452	0.0647604	10.0389
9	0.32824	1.52357	0.0708180	10.0356
10	0.30391	1.62876	0.0762199	10.0330
11	0.27747	1.71956	0.0809417	10.0311
12	0.24822	1.79544	0.0849569	10.0296
13	0.21504	1.85655	0.0882575	10.0285
14	0.17570	1.90278	0.0908484	10.0277
15	0.12451	1.93342	0.0927242	10.0272
16	0.00000	1.95706	0.0933690	10.0268

THE RENOLDS NO. IS 0.53113995E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.0010847 LB/IN<sup>2</sup> IN/FT.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CM FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	10.2020
2	0.40108	0.19335	0.0124257	10.1929
3	0.60429	0.41315	0.021691	10.1004
4	0.81148	0.61145	0.0342811	10.0736
5	1.02083	0.79805	0.0458171	10.0529
6	1.23119	0.9676	0.0503253	10.0449
7	1.35231	1.12920	0.0526888	10.0434
8	1.37515	1.27506	0.0543604	10.0389
9	1.32089	1.40425	0.0508180	10.0326
10	1.35854	1.52325	0.0452199	10.0330
11	1.30391	1.62879	0.0399917	10.0311
12	1.23445	1.71926	0.0349269	10.0299
13	1.14825	1.79944	0.0282522	10.0282
14	1.05204	1.86922	0.0208484	10.0277
15	0.93570	1.90579	0.0125245	10.0275
16	0.82421	1.93345	0.0033990	10.0259
	0.00000	1.95106		

THE REYNOLDS NO. IS 0.29113925E 03



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 12 .

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010836 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48191	0.19260	0.0052759	10.7970
2	0.46462	0.41337	0.0154927	10.2538
3	0.44752	0.61146	0.0251661	10.1522
4	0.42987	0.79592	0.0342811	10.1113
5	0.41151	0.96747	0.0428171	10.0890
6	0.39233	1.12604	0.0507523	10.0751
7	0.37218	1.27146	0.0580688	10.0656
8	0.35089	1.40380	0.0647604	10.0588
9	0.32822	1.52271	0.0708180	10.0538
10	0.30387	1.62776	0.0762199	10.0499
11	0.27740	1.71842	0.0809417	10.0470
12	0.24812	1.79415	0.0849569	10.0448
13	0.21489	1.85513	0.0882575	10.0431
14	0.17548	1.90123	0.0908484	10.0419
15	0.12412	1.93175	0.0927242	10.0410
16	0.00000	1.95524	0.0933690	10.0404

THE RENOLDS NO. IS 0.53169151E 03 .

THE RESULTS NO. IS 0.2318121E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
16	0.00700	1.92254	0.0033600	10.0404
15	0.12415	1.93175	0.0252545	10.0410
14	0.21489	1.82213	0.0408404	10.0419
13	0.28415	1.79415	0.0885252	10.0431
12	0.33415	1.79415	0.0849280	10.0444
11	0.37440	1.71845	0.0800417	10.0470
10	0.30397	1.65276	0.0705199	10.0499
9	0.35855	1.55521	0.0708180	10.0538
8	0.32084	1.40380	0.0447804	10.0588
7	0.32518	1.52146	0.0200888	10.0629
6	0.39233	1.15804	0.0207253	10.0721
5	0.41121	0.99747	0.0458171	10.0890
4	0.42987	0.79295	0.0345811	10.1113
3	0.44725	0.61146	0.021681	10.1252
2	0.46465	0.41337	0.0124057	10.1529
1	0.48191	0.19200	0.0025259	10.1970
	0.50000	0.00000		

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010836 LB/20 IN/FT.

THE INCREMENT NUMBER IN LENGTH IS .

THE AGE OF FLOW IS 1.0000 MIN.



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 13 .

AT 6.300 FEET, THE PRESSURE GRADIENT IS 0.0011364 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	1.0000
	0.47521	0.14255		
2			0.0154927	10.3472
	0.45577	0.41190		
3			0.0251661	10.2039
	0.43855	0.62638		
4			0.0342811	10.1487
	0.42106	0.82283		
5			0.0428171	10.1187
	0.40298	1.00445		
6			0.0507523	10.1000
	0.38414	1.17190		
7			0.0580688	10.0873
	0.36438	1.32519		
8			0.0647604	10.0783
	0.34352	1.46444		
9			0.0708180	10.0716
	0.32133	1.58955		
10			0.0762199	10.0665
	0.29752	1.70009		
11			0.0809417	10.0626
	0.27164	1.79554		
12			0.0849569	10.0596
	0.24303	1.87530		
13			0.0882575	10.0574
	0.21058	1.93937		
14			0.0908484	10.0558
	0.17214	1.98779		
15			0.0927242	10.0546
	0.12213	2.01988		
16			0.0933690	10.0538
	0.00000	2.04375		

THE RENOLDS NO. IS 0.50700501E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 6.300 FEET, THE PRESSURE GRADIENT IS 0.001384 LB/IN<sup>2</sup> INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	1.0000
2	0.4251	0.1455	0.012495	10.3475
3	0.4527	0.4119	0.021661	10.5039
4	0.4332	0.6263	0.034511	10.1487
5	0.4510	0.8528	0.045811	10.1187
6	0.4059	1.0045	0.020753	10.1000
7	0.3844	1.1719	0.028088	10.0873
8	0.3643	1.3519	0.044604	10.0783
9	0.3432	1.4644	0.070810	10.0719
10	0.3513	1.2922	0.074519	10.0692
11	0.5925	1.7009	0.080917	10.0659
12	0.5764	1.7924	0.084929	10.0299
13	0.5430	1.8230	0.082512	10.0274
14	0.5102	1.9393	0.090848	10.0228
15	0.1751	1.9879	0.092545	10.0249
16	0.1551	2.0198	0.093390	10.0299
	0.0000	2.0432		

THE REYNOLDS NO. IS 0.2070201E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 9.500 FEET, THE PRESSURE GRADIENT IS 0.0012227 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.46271	0.09732	0.0052759	1.0000
2	0.44149	0.42726	0.0154927	10.5489
3	0.42457	0.66186	0.0251661	10.3034
4	0.40754	0.87464	0.0342811	10.2197
5	0.39001	1.07084	0.0428171	10.1750
6	0.37178	1.25161	0.0507523	10.1473
7	0.35268	1.41714	0.0580688	10.1285
8	0.33255	1.56730	0.0647604	10.1151
9	0.31115	1.70221	0.0708180	10.1052
10	0.28820	1.82156	0.0762199	10.0977
11	0.26329	1.92479	0.0809417	10.0920
12	0.23579	2.01126	0.0849569	10.0876
13	0.20464	2.08057	0.0882575	10.0843
14	0.16783	2.13301	0.0908484	10.0819
15	0.12025	2.16795	0.0927242	10.0803
16	0.00000	2.19288	0.0933690	10.0790

THE RENOLDS NO. IS 0.47122401E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 9.200 FEET, THE PRESSURE GRADIENT IS 0.0015557 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025724	1.0000
2	0.45211	0.09135	0.0124957	10.2489
3	0.44149	0.45156	0.0521661	10.3034
4	0.45457	0.66186	0.0345811	10.5147
5	0.40154	0.87464	0.0458171	10.1720
6	0.39001	1.07084	0.0505253	10.1473
7	0.37176	1.25161	0.0528688	10.1585
8	0.35268	1.41714	0.0647404	10.1121
9	0.33252	1.56730	0.0708180	10.1025
10	0.31112	1.70551	0.0765199	10.0977
11	0.28850	1.85159	0.0804417	10.0950
12	0.26359	1.95479	0.0849269	10.0879
13	0.23279	2.01756	0.0885272	10.0843
14	0.20464	2.08027	0.0408484	10.0819
15	0.16783	2.13301	0.0957545	10.0803
16	0.12052	2.16745	0.0933890	10.0790
	0.00000	2.16588		

THE RINGLOS NO. IS 0.4715540E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 15 .

AT 12.700 FEET, THE PRESSURE GRADIENT IS 0.0012454 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.46381	0.10002	0.0052759	1.0000
2	0.44036	0.38659	0.0154927	10.7670
3	0.42231	0.64697	0.0251661	10.4032
4	0.40493	0.87166	0.0342811	10.2891
5	0.38726	1.07583	0.0428171	10.2296
6	0.36899	1.26270	0.0507523	10.1929
7	0.34992	1.43318	0.0580688	10.1682
8	0.32984	1.58746	0.0647604	10.1506
9	0.30853	1.72578	0.0708180	10.1376
10	0.28568	1.84800	0.0762199	10.1277
11	0.26088	1.95362	0.0809417	10.1202
12	0.23351	2.04199	0.0849569	10.1145
13	0.20250	2.11268	0.0882575	10.1102
14	0.16581	2.16602	0.0908484	10.1070
15	0.11826	2.20140	0.0927242	10.1048
16	0.00000	2.22600	0.0933690	10.1033

THE RENOLDS NO. IS 0.46261030E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 12 .

AT 15.700 FEET, THE PRESSURE GRADIENT IS 0.001544 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002329	1.0000
2	0.40001	0.10005	0.012432	10.1670
3	0.60030	0.38029	0.021001	10.4035
4	0.80231	0.64097	0.034581	10.5891
5	0.90493	0.87166	0.045811	10.5549
6	0.98120	1.07293	0.050723	10.1929
7	0.98899	1.25210	0.058088	10.1685
8	0.94995	1.43318	0.064304	10.1509
9	0.85984	1.58749	0.070818	10.1376
10	0.70823	1.75278	0.076519	10.1571
11	0.58268	1.84600	0.080417	10.1505
12	0.50099	1.92395	0.084929	10.1149
13	0.53321	2.04199	0.088525	10.1105
14	0.50520	2.11508	0.090884	10.1070
15	0.16281	2.16005	0.0921545	10.1048
16	0.11856	2.50140	0.0933990	10.1033
	0.00000	2.55800		

THE RADIUS NO. IS 0.48591030E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 19.100 FEET, THE PRESSURE GRADIENT IS 0.0012999 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	1.0000
	0.46622	0.10659		
2			0.0154927	1.0000
	0.43681	0.30209		
3			0.0251661	10.6220
	0.41629	0.62383		
4			0.0342811	10.4300
	0.39843	0.87249		
5			0.0428171	10.3382
	0.38065	1.09287		
6			0.0507523	10.2829
	0.36244	1.29239		
7			0.0580688	10.2461
	0.34353	1.47342		
8			0.0647604	10.2200
	0.32368	1.63673		
9			0.0708180	10.2008
	0.30266	1.78265		
10			0.0762199	10.1863
	0.28014	1.91139		
11			0.0809417	10.1753
	0.25572	2.02252		
12			0.0849569	10.1668
	0.22876	2.11544		
13			0.0882575	10.1605
	0.19822	2.18953		
14			0.0908484	10.1559
	0.16206	2.24523		
15			0.0927242	10.1527
	0.11506	2.28197		
16			0.0933690	10.1505
	0.00000	2.30634		

THE RENOLDS NO. IS 0.44321858E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 10 .

AT 10.100 FEET, THE PRESSURE GRADIENT IS 0.001593 FLOW INVT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	1.0000
2	0.40000	0.10259	0.0124952	1.0000
3	0.60000	0.30509	0.021681	10.6550
4	0.80000	0.65389	0.0345011	10.4300
5	1.00000	0.85549	0.0458171	10.3389
6	1.20000	1.02589	0.0505253	10.5859
7	1.40000	1.25239	0.0580888	10.5491
8	1.60000	1.45399	0.0645004	10.5500
9	1.80000	1.63919	0.0708180	10.5008
10	2.00000	1.78599	0.0765199	10.1893
11	2.20000	1.91139	0.0809417	10.1723
12	2.40000	2.05259	0.0849299	10.1699
13	2.60000	2.11249	0.0885212	10.1602
14	2.80000	2.18929	0.0908484	10.1229
15	3.00000	2.24259	0.0931245	10.1251
16	3.20000	2.28199	0.0933990	10.1202

THE REYNOLDS NO. IS 0.44351828E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 25.500 FEET, THE PRESSURE GRADIENT IS 0.0013842 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.46941	0.11695	0.0052759	1.0000
2	0.43429	0.22649	0.0154927	1.0000
3	0.40931	0.56047	0.0251661	10.8768
4	0.39003	0.86075	0.0342811	10.5756
5	0.37189	1.11074	0.0428171	10.4461
6	0.35366	1.33216	0.0507523	10.3710
7	0.33491	1.53090	0.0580688	10.3217
8	0.31534	1.70913	0.0647604	10.2871
9	0.29469	1.86766	0.0708180	10.2617
10	0.27262	2.00702	0.0762199	10.2426
11	0.24871	2.12714	0.0809417	10.2281
12	0.22235	2.22747	0.0849569	10.2170
13	0.19249	2.30729	0.0882575	10.2087
14	0.15711	2.36688	0.0908484	10.2026
15	0.11101	2.40594	0.0927242	10.1985
16	0.00000	2.43015	0.0933690	10.1956

THE RENOLDS NO. IS 0.41623549E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 22.500 FEET, THE PRESSURE GRADIENT IS 0.0013845 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025159	1.0000
2	0.40001	0.11002	0.0124957	1.0000
3	0.43459	0.22009	0.0212981	10.8168
4	0.40031	0.28047	0.0345811	10.2529
5	0.39003	0.88072	0.0458171	10.4461
6	0.37189	1.11074	0.0507253	10.3710
7	0.32399	1.33219	0.0280988	10.3517
8	0.33401	1.23000	0.0647004	10.2871
9	0.31234	1.70913	0.0709180	10.2917
10	0.29499	1.89799	0.0795199	10.2459
11	0.25292	2.00702	0.0809417	10.2581
12	0.24871	2.12714	0.0849299	10.2170
13	0.22532	2.22747	0.0825252	10.2087
14	0.19249	2.30754	0.0908484	10.2029
15	0.12711	2.39998	0.0937542	10.1982
16	0.11101	2.40294	0.0933990	10.1929
17	0.00000	2.43012		

THE REYNOLDS NO. IS 0.4183249E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0014952 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47283	0.13075	0.0052759	1.0000
2	0.44448	0.24622	0.0154927	1.0000
3	0.41179	0.35533	0.0251661	1.0000
4	0.38566	0.72293	0.0342811	10.9221
5	0.36518	1.05413	0.0428171	10.6736
6	0.34610	1.32342	0.0507523	10.5477
7	0.32704	1.55686	0.0580688	10.4700
8	0.30748	1.76245	0.0647604	10.4170
9	0.28703	1.94342	0.0708180	10.3787
10	0.26532	2.10114	0.0762199	10.3502
11	0.24191	2.23643	0.0809417	10.3286
12	0.21617	2.34916	0.0849569	10.3123
13	0.18709	2.43870	0.0882575	10.3001
14	0.15268	2.50499	0.0908484	10.2912
15	0.10789	2.54826	0.0927242	10.2852
16	0.00000	2.57365	0.0933690	10.2811

THE RENOLDS NO. IS 0.38532238E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0014025 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	1.0000
2	0.47583	0.13012	0.0124927	1.0000
3	0.44448	0.24852	0.0221881	1.0000
4	0.41179	0.32233	0.0345811	10.2551
5	0.38286	0.45233	0.0428171	10.2730
6	0.36218	1.02413	0.0201253	10.2477
7	0.34810	1.32342	0.0280888	10.4700
8	0.32704	1.22888	0.0247604	10.4170
9	0.30748	1.78242	0.0708180	10.3787
10	0.28703	1.24342	0.0785700	10.3205
11	0.26232	2.10114	0.0808417	10.3588
12	0.24191	2.23843	0.0840289	10.3123
13	0.21817	2.34818	0.0802272	10.3001
14	0.18709	2.43870	0.0808484	10.2915
15	0.12568	2.20449	0.0651242	10.2822
16	0.10789	2.24828	0.0633890	10.2411
	0.00000	2.27382		

THE REYNOLDS NO. IS 0.3823523E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 51.100 FEET, THE PRESSURE GRADIENT IS 0.0015976 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47542	0.14369	0.0052759	1.0000
2	0.44993	0.27210	0.0154927	1.0000
3	0.42229	0.38991	0.0251661	1.0000
4	0.39115	0.49843	0.0342811	1.0000
5	0.36448	0.88492	0.0428171	10.9466
6	0.34295	1.23924	0.0507523	10.7366
7	0.32289	1.52293	0.0580688	10.6207
8	0.30288	1.76445	0.0647604	10.5457
9	0.28229	1.97322	0.0708180	10.4930
10	0.26066	2.15318	0.0762199	10.4544
11	0.23749	2.30629	0.0809417	10.4254
12	0.21214	2.43336	0.0849569	10.4036
13	0.18359	2.53411	0.0882575	10.3874
14	0.14990	2.60825	0.0908484	10.3756
15	0.10618	2.65644	0.0927242	10.3677
16	0.00000	2.68389	0.0933690	10.3625

THE RENOLDS NO. IS 0.36064397E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 21.100 FEET, THE PRESSURE GRADIENT IS 0.0012978 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	1.0000
2	0.42545	0.14399	0.0124957	1.0000
3	0.44993	0.25210	0.0221991	1.0000
4	0.45559	0.38991	0.0345811	1.0000
5	0.39115	0.49843	0.0458171	10.9999
6	0.38448	0.88445	0.0201253	10.1399
7	0.34592	1.23954	0.0280888	10.6537
8	0.35589	1.25593	0.0647604	10.2457
9	0.30588	1.76445	0.0709180	10.4430
10	0.28559	1.93355	0.0795199	10.4544
11	0.29099	2.12319	0.0809417	10.4554
12	0.23749	2.30959	0.0849299	10.4039
13	0.21514	2.43339	0.0895215	10.3874
14	0.18359	2.23411	0.0908484	10.3759
15	0.14990	2.60852	0.0952545	10.3977
16	0.10918	2.69944	0.0933990	10.3952
	0.00000	2.68389		

THE REYNOLDS NO. IS 0.3609347E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0017728 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47902	0.16705	0.0052759	1.0000
2	0.45742	0.31826	0.0154927	1.0000
3	0.43437	0.45868	0.0251661	1.0000
4	0.40970	0.58725	0.0342811	1.0000
5	0.38312	0.70336	0.0428171	1.0000
6	0.35365	0.80761	0.0507523	1.0000
7	0.32616	1.20356	0.0580688	10.9803
8	0.30259	1.57946	0.0647604	10.8250
9	0.28024	1.87412	0.0708180	10.7294
10	0.25767	2.11640	0.0762199	10.6639
11	0.23407	2.31681	0.0809417	10.6168
12	0.20864	2.48012	0.0849569	10.5821
13	0.18029	2.60839	0.0882575	10.5566
14	0.14707	2.70175	0.0908484	10.5385
15	0.10413	2.76139	0.0927242	10.5264
16	0.00000	2.79310	0.0933690	10.5187

THE RENOLDS NO. IS 0.32500016E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.001758 LBS/INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	1.0000
2	0.40002	0.16702	0.012432	1.0000
3	0.60004	0.31826	0.021661	1.0000
4	0.80006	0.42868	0.034291	1.0000
5	1.00008	0.58722	0.045817	1.0000
6	1.20010	0.70336	0.050252	1.0000
7	1.40012	0.80761	0.059088	10.2803
8	1.60014	1.20328	0.064704	10.8220
9	1.80016	1.27446	0.070918	10.1294
10	2.00018	1.84412	0.076213	10.6933
11	2.20020	2.11640	0.080417	10.8168
12	2.40022	2.31881	0.084029	10.2821
13	2.60024	2.48012	0.082212	10.2266
14	2.80026	2.60839	0.040848	10.2382
15	3.00028	2.70122	0.042242	10.2224
16	3.20030	2.76139	0.033860	10.2181

THE REYNOLDS NO. IS 0.320018 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 102.300 FEET, THE PRESSURE GRADIENT IS 0.0019379 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48168	0.19034	0.0052759	1.0000
2	0.46293	0.36456	0.0154927	1.0000
3	0.44315	0.52743	0.0251661	1.0000
4	0.42227	0.67801	0.0342811	1.0000
5	0.40011	0.81610	0.0428171	1.0000
6	0.37647	0.94141	0.0507523	1.0000
7	0.35102	1.05354	0.0580688	1.0000
8	0.32322	1.15199	0.0647604	1.0000
9	0.29372	1.35436	0.0708180	1.0000
10	0.26584	1.77073	0.0762199	10.9038
11	0.23942	2.07578	0.0809417	10.8220
12	0.21220	2.31092	0.0849569	10.7672
13	0.18264	2.48987	0.0882575	10.7286
14	0.14854	2.61786	0.0908484	10.7018
15	0.10484	2.69722	0.0927242	10.6842
16	0.00000	2.73585	0.0933690	10.6734

THE RENOLDS NO. IS 0.29730186E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 105.300 FEET, THE PRESSURE GRADIENT IS 0.0019379 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025259	1.0000
2	0.48188	0.19034	0.0124452	1.0000
3	0.46503	0.36426	0.021661	1.0000
4	0.44812	0.52743	0.0342811	1.0000
5	0.43252	0.67801	0.0458171	1.0000
6	0.40811	0.81810	0.0502523	1.0000
7	0.37642	0.94141	0.0560688	1.0000
8	0.35105	1.05354	0.0642604	1.0000
9	0.32355	1.15198	0.0700180	1.0000
10	0.29325	1.24436	0.0725199	10.9038
11	0.26264	1.32023	0.0800412	10.0550
12	0.23345	1.37210	0.0844269	10.2425
13	0.21520	1.40425	0.0885212	10.2589
14	0.18564	1.48682	0.0909484	10.2018
15	0.14824	1.61286	0.0922545	10.0845
16	0.10484	1.69125	0.0933690	10.0234
	0.00000	1.73282		

THE REYNOLDS NO. IS 0.25230186 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 22 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.0021408 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	1.0000
	0.48412	0.22117		
2			0.0154927	1.0000
	0.46810	0.42407		
3			0.0251661	1.0000
	0.45138	0.61578		
4			0.0342811	1.0000
	0.43393	0.79511		
5			0.0428171	1.0000
	0.41569	0.96153		
6			0.0507523	1.0000
	0.39655	1.11476		
7			0.0580688	1.0000
	0.37638	1.25468		
8			0.0647604	1.0000
	0.35500	1.38135		
9			0.0708180	1.0000
	0.33221	1.49467		
10			0.0762199	1.0000
	0.30767	1.59427		
11			0.0809417	1.0000
	0.28094	1.67948		
12			0.0849569	1.0000
	0.25133	1.74987		
13			0.0882575	1.0000
	0.21765	1.80547		
14			0.0908484	1.0000
	0.17759	1.84660		
15			0.0927242	1.0000
	0.12525	1.87448		
16			0.0933690	1.0000
	0.00000	1.88652		

THE RENOLDS NO. IS 0.26912673E 03 .



THE AGE OF FLOW IS 1.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 55 .

AT 153.200 FEET, THE PRESSURE GRADIENT IS 0.0051408 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052529	1.0000
2	0.48415	0.25117	0.0154957	1.0000
3	0.46810	0.45407	0.0521661	1.0000
4	0.45138	0.61278	0.0345811	1.0000
5	0.43393	0.79211	0.0458171	1.0000
6	0.41568	0.98123	0.0502523	1.0000
7	0.39652	1.17476	0.0580888	1.0000
8	0.37638	1.52498	0.0647904	1.0000
9	0.35520	1.38132	0.0708180	1.0000
10	0.33221	1.49497	0.0752199	1.0000
11	0.30767	1.59457	0.0809417	1.0000
12	0.28094	1.67998	0.0843299	1.0000
13	0.25133	1.74987	0.0885212	1.0000
14	0.21762	1.80247	0.0908484	1.0000
15	0.17729	1.84660	0.0927545	1.0000
16	0.15222	1.87448	0.0933990	1.0000
	0.00000	1.88925		

THE RINGDOWS NO. IS 0.5915673E 03 .

THE AGE OF FLOW IS 1.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)		PRESSURE (LB/SQ IN)
0.000		0.00000
0.100		0.00031
0.300		0.00092
0.700		0.00216
1.500		0.00462
3.100		0.00689
6.300		0.01039
12.700		0.01815
25.500		0.03485
51.100		0.07309
102.300		0.16377
204.700		0.37953
409.500		0.81797
819.100		1.69485
1638.300		3.44861
3276.700		6.95614
6553.500		13.97118
13107.100		28.00128
26214.300		56.06147
52428.699		112.18186
104857.498		224.42263
209715.096		448.90418
419430.293		897.86727
528000.000		1130.29578

WITH 528000.0 FT., THE DROP IN PRESSURE IS 1130.2958 LB/SQ IN.

THE AGE OF FLOW IS 1.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LB/IN<sup>2</sup>)

0.0000	0.000
0.0001	0.100
0.0002	0.300
0.0005	0.700
0.0010	1.200
0.0020	3.100
0.0050	6.300
0.0100	12.700
0.0200	22.200
0.0300	24.100
0.0500	102.300
0.0700	204.700
0.1000	409.200
0.1500	819.100
0.2000	1638.300
0.3000	3276.700
0.5000	6553.200
0.7000	13107.100
1.0000	26214.300
1.5000	52428.600
2.0000	104857.200
3.0000	209714.400
5.0000	419428.800
7.0000	528000.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 1130.528 LB/IN<sup>2</sup>.



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11 .

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.0010810 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48226	0.19625	0.0052759	10.4763
2	0.46514	0.41353	0.0154927	10.1628
3	0.44804	0.61049	0.0251661	10.1003
4	0.43039	0.79419	0.0342811	10.0737
5	0.41202	0.96513	0.0428171	10.0591
6	0.39282	1.12319	0.0507523	10.0498
7	0.37265	1.26817	0.0580688	10.0436
8	0.35132	1.40012	0.0647604	10.0391
9	0.32863	1.51871	0.0708180	10.0357
10	0.30425	1.62346	0.0762199	10.0332
11	0.27774	1.71387	0.0809417	10.0313
12	0.24842	1.78941	0.0849569	10.0298
13	0.21514	1.85024	0.0882575	10.0287
14	0.17568	1.89622	0.0908484	10.0279
15	0.12425	1.92666	0.0927242	10.0273
16	0.00000	1.95013	0.0933690	10.0269

THE RENOLDS NO. IS 0.53296310E 03 .

THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11.

AT 3.100 FEET, THE PRESSURE GRADIENT IS 0.001010 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0055559	10.4563
2	0.48559	0.19955	0.0154955	10.1658
3	0.46519	0.41353	0.0551691	10.1003
4	0.44804	0.61049	0.0345811	10.0535
5	0.43039	0.79919	0.0458151	10.0291
6	0.41505	0.98513	0.0505553	10.0499
7	0.39585	1.15319	0.0580998	10.0439
8	0.37595	1.50815	0.0645694	10.0391
9	0.35135	1.40015	0.0508180	10.0355
10	0.35893	1.51851	0.0555199	10.0335
11	0.30455	1.95349	0.0609451	10.0315
12	0.55555	1.51385	0.0849299	10.0598
13	0.54845	1.58941	0.0885555	10.0585
14	0.55514	1.82054	0.0908484	10.0553
15	0.55598	1.89255	0.0955545	10.0553
16	0.55455	1.95999	0.0933990	10.0559
	0.00000	1.95013		

THE REYNOLDS NO. IS 0.5359310E 03.



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 12 .

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010802 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48229	0.19660	0.0052759	10.7581
2	0.46518	0.41396	0.0154927	10.2503
3	0.44809	0.61084	0.0251661	10.1521
4	0.43043	0.79444	0.0342811	10.1115
5	0.41207	0.96529	0.0428171	10.0893
6	0.39287	1.12326	0.0507523	10.0753
7	0.37270	1.26815	0.0580688	10.0658
8	0.35137	1.40001	0.0647604	10.0590
9	0.32867	1.51852	0.0708180	10.0540
10	0.30429	1.62321	0.0762199	10.0501
11	0.27778	1.71356	0.0809417	10.0472
12	0.24845	1.78903	0.0849569	10.0450
13	0.21517	1.84981	0.0882575	10.0433
14	0.17569	1.89575	0.0908484	10.0421
15	0.12425	1.92617	0.0927242	10.0412
16	0.00000	1.94964	0.0933690	10.0406

THE RENOLDS NO. IS 0.53337272E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 15 .

AT 4.700 FEET, THE PRESSURE GRADIENT IS 0.0010805 LBS/2 INCH.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.005128	10.1281
2	0.48528	0.19880	0.012452	10.1253
3	0.46518	0.41346	0.052168	10.1251
4	0.44809	0.61084	0.034581	10.1115
5	0.43043	0.79444	0.045811	10.0893
6	0.41507	0.96528	0.050152	10.0753
7	0.39587	1.12326	0.058088	10.0628
8	0.37510	1.26812	0.064180	10.0590
9	0.35137	1.40001	0.0708180	10.0540
10	0.32867	1.51825	0.075213	10.0501
11	0.30459	1.62351	0.080417	10.0475
12	0.27716	1.71326	0.084459	10.0450
13	0.24845	1.78903	0.088523	10.0433
14	0.21517	1.84981	0.090848	10.0451
15	0.17569	1.89525	0.095154	10.0415
16	0.15452	1.95617	0.097360	10.0408
	0.00000	1.94464		

THE REYNOLDS NO. IS 0.23332575 03 .

THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 13 .

AT 6.300 FEET, THE PRESSURE GRADIENT IS 0.0010794 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48231	0.19686	0.0052759	11.0393
2	0.46522	0.41420	0.0154927	10.3377
3	0.44814	0.61098	0.0251661	10.2039
4	0.43049	0.79447	0.0342811	10.1493
5	0.41212	0.96522	0.0428171	10.1195
6	0.39292	1.12310	0.0507523	10.1008
7	0.37275	1.26791	0.0580688	10.0881
8	0.35143	1.39970	0.0647604	10.0790
9	0.32873	1.51814	0.0708180	10.0722
10	0.30434	1.62276	0.0762199	10.0671
11	0.27782	1.71304	0.0809417	10.0632
12	0.24850	1.78845	0.0849569	10.0602
13	0.21521	1.84918	0.0882575	10.0579
14	0.17572	1.89509	0.0908484	10.0563
15	0.12426	1.92549	0.0927242	10.0552
16	0.00000	1.94896	0.0933690	10.0543

THE RENOLDS NO. IS 0.53378570E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 13.

AT 0.300 FEET, THE PRESSURE GRADIENT IS 0.0010794 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0055529	11.0393
2	0.48531	0.14888	0.0154957	10.3377
3	0.46555	0.41450	0.0521681	10.5039
4	0.44814	0.61098	0.0345811	10.1433
5	0.43049	0.73447	0.0458171	10.1192
6	0.41515	0.88555	0.0507553	10.1008
7	0.39595	1.15310	0.0500988	10.0881
8	0.37575	1.58791	0.0647604	10.0790
9	0.35143	1.39370	0.0708180	10.0755
10	0.32873	1.71814	0.0765199	10.0711
11	0.30434	1.65576	0.0809417	10.0635
12	0.27785	1.71304	0.0844599	10.0605
13	0.24850	1.78945	0.0885555	10.0579
14	0.21551	1.84918	0.0908484	10.0583
15	0.17575	1.89509	0.0927545	10.0525
16	0.15459	1.95749	0.0933990	10.0543
	0.00000	1.94896		

THE REYNOLDS NO. IS 0.5337050E 03.



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 9.500 FEET, THE PRESSURE GRADIENT IS 0.0010779 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	11.6002
	0.48235	0.19725		
2			0.0154927	10.5121
	0.46527	0.41463		
3			0.0251661	10.3073
	0.44821	0.61125		
4			0.0342811	10.2249
	0.43057	0.79458		
5			0.0428171	10.1799
	0.41221	0.96517		
6			0.0507523	10.1517
	0.39301	1.12291		
7			0.0580688	10.1326
	0.37284	1.26760		
8			0.0647604	10.1189
	0.35151	1.39927		
9			0.0708180	10.1087
	0.32881	1.51758		
10			0.0762199	10.1010
	0.30442	1.62208		
11			0.0809417	10.0951
	0.27790	1.71224		
12			0.0849569	10.0906
	0.24856	1.78754		
13			0.0882575	10.0872
	0.21526	1.84818		
14			0.0908484	10.0847
	0.17577	1.89403		
15			0.0927242	10.0830
	0.12429	1.92439		
16			0.0933690	10.0818
	0.00000	1.94787		

THE RENOLDS NO. IS 0.53453618E 03 .

THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 14 .

AT 9.200 FEET, THE PRESSURE GRADIENT IS 0.0010779 LB\529 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CM FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052529	11.6005
2	0.48535	0.19155	0.0154957	10.5151
3	0.46257	0.41463	0.0521661	10.3073
4	0.44851	0.61152	0.0345811	10.5549
5	0.43057	0.79459	0.0458171	10.1799
6	0.41551	0.96517	0.0507553	10.1517
7	0.39301	1.15591	0.0580688	10.1356
8	0.37584	1.56160	0.0647604	10.1189
9	0.35151	1.39957	0.0708180	10.1087
10	0.33881	1.51758	0.0795199	10.1010
11	0.30445	1.65508	0.0809417	10.0951
12	0.57100	1.71554	0.0649569	10.0906
13	0.54856	1.78754	0.0885575	10.0875
14	0.51556	1.84818	0.0908484	10.0847
15	0.17577	1.89403	0.0957545	10.0830
16	0.15459	1.95439	0.0933690	10.0819
	0.00000	1.94797		

THE REYNOLDS NO. IS 0.53453918E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 15 .

AT 12.700 FEET, THE PRESSURE GRADIENT IS 0.0011155 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47766	0.15740	0.0052759	2.0000
2	0.45889	0.41165	0.0154927	10.6945
3	0.44170	0.62087	0.0251661	10.4106
4	0.42415	0.81321	0.0342811	10.2999
5	0.40598	0.99127	0.0428171	10.2396
6	0.38702	1.15555	0.0507523	10.2020
7	0.36712	1.30600	0.0580688	10.1765
8	0.34611	1.44273	0.0647604	10.1582
9	0.32376	1.56556	0.0708180	10.1446
10	0.29975	1.67404	0.0762199	10.1344
11	0.27367	1.76767	0.0809417	10.1265
12	0.24482	1.84585	0.0849569	10.1206
13	0.21209	1.90869	0.0882575	10.1160
14	0.17329	1.95620	0.0908484	10.1127
15	0.12279	1.98767	0.0927242	10.1105
16	0.00000	2.01143	0.0933690	10.1088

THE RENOLDS NO. IS 0.51651078E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 15

AT 15.700 FEET, THE PRESSURE GRADIENT IS 0.001125 LB/25 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	5.0000
2	0.47760	0.12740	0.0124327	10.6945
3	0.42389	0.41162	0.0221681	10.4106
4	0.44170	0.62027	0.0345811	10.2999
5	0.42412	0.81321	0.0428171	10.2396
6	0.40248	0.99127	0.0507923	10.2020
7	0.38702	1.12222	0.0580688	10.1762
8	0.36712	1.30600	0.0647604	10.1585
9	0.34611	1.44273	0.0708180	10.1446
10	0.32370	1.52220	0.0725199	10.1344
11	0.29922	1.67404	0.0804417	10.1260
12	0.27367	1.76767	0.0844269	10.1202
13	0.24482	1.84282	0.0852572	10.1160
14	0.21209	1.90869	0.0900484	10.1121
15	0.17329	1.92620	0.0925242	10.1102
16	0.12279	1.98767	0.0933990	10.1082
	0.00000	5.01143		

THE REYNOLDS NO. IS 0.21621078E 03

THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 19.100 FEET, THE PRESSURE GRADIENT IS 0.0011570 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47172	0.12590	0.0052759	2.0000
2	0.45160	0.41632	0.0154927	11.0879
3	0.43447	0.63709	0.0251661	10.6151
4	0.41712	0.83823	0.0342811	10.4465
5	0.39920	1.02388	0.0428171	10.3560
6	0.38054	1.19495	0.0507523	10.2997
7	0.36098	1.35156	0.0580688	10.2616
8	0.34033	1.49374	0.0647604	10.2344
9	0.31838	1.62146	0.0708180	10.2142
10	0.29481	1.73429	0.0762199	10.1990
11	0.26921	1.83172	0.0809417	10.1873
12	0.24091	1.91312	0.0849569	10.1785
13	0.20883	1.97842	0.0882575	10.1718
14	0.17083	2.02779	0.0908484	10.1669
15	0.12148	2.06056	0.0927242	10.1635
16	0.00000	2.08475	0.0933690	10.1610

THE RENOLDS NO. IS 0.49797727E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 19.100 FEET, THE PRESSURE GRADIENT IS 0.001250 LB/250 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	5.0000
2	0.41715	0.15200	0.0124957	11.0819
3	0.42160	0.41935	0.0521661	10.6121
4	0.43447	0.63709	0.0345811	10.4482
5	0.47175	0.63853	0.0458171	10.3260
6	0.39950	1.05788	0.0507553	10.5497
7	0.38024	1.19495	0.0580688	10.5216
8	0.36098	1.32150	0.0647604	10.5344
9	0.34033	1.49314	0.0700180	10.5145
10	0.31836	1.65149	0.0765199	10.1990
11	0.29481	1.73459	0.0809417	10.1813
12	0.26951	1.83155	0.0849569	10.1762
13	0.24091	1.91315	0.0895515	10.1718
14	0.20803	1.97845	0.0908484	10.1669
15	0.17083	2.05779	0.0951545	10.1632
16	0.15148	2.06026	0.0933690	10.1610
	0.00000	2.06415		

THE REYNOLDS NO. IS 0.493151E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 25.500 FEET, THE PRESSURE GRADIENT IS 0.0011734 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47234	0.12850	0.0052759	2.0000
2	0.45078	0.38311	0.0154927	11.5047
3	0.43272	0.62360	0.0251661	10.8213
4	0.41508	0.83409	0.0342811	10.5913
5	0.39705	1.02605	0.0428171	10.4702
6	0.37836	1.20196	0.0507523	10.3953
7	0.35882	1.36250	0.0580688	10.3449
8	0.33823	1.50792	0.0647604	10.3089
9	0.31635	1.63835	0.0708180	10.2823
10	0.29288	1.75347	0.0762199	10.2621
11	0.26739	1.85279	0.0809417	10.2467
12	0.23923	1.93571	0.0849569	10.2350
13	0.20730	2.00209	0.0882575	10.2262
14	0.16946	2.05223	0.0908484	10.2197
15	0.12026	2.08543	0.0927242	10.2153
16	0.00000	2.10954	0.0933690	10.2120

THE RENOLDS NO. IS 0.49099204E 03 .

THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 52.500 FEET, THE PRESSURE GRADIENT IS 0.001134 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025759	5.0000
2	0.45394	0.15850	0.0124957	11.2047
3	0.42078	0.38311	0.0521661	10.8513
4	0.43575	0.63360	0.0345911	10.2913
5	0.41509	0.83409	0.0458171	10.4705
6	0.39705	1.05605	0.0207253	10.3923
7	0.37836	1.50166	0.0290888	10.3449
8	0.35885	1.36550	0.0647604	10.3039
9	0.33953	1.50795	0.0706180	10.5853
10	0.31632	1.63832	0.0725199	10.5951
11	0.29588	1.75347	0.0509417	10.5497
12	0.28739	1.85519	0.0849299	10.5320
13	0.23953	1.93271	0.0885275	10.5525
14	0.50730	5.00509	0.0408484	10.5197
15	0.16946	5.02553	0.0251545	10.5153
16	0.15058	5.08243	0.0433990	10.5150
17	0.00000	5.10954		

THE REYNOLDS NO. IS 0.4409204E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0012078 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47354	0.13402	0.0052759	2.0000
2	0.44873	0.31907	0.0154927	2.0000
3	0.42872	0.60296	0.0251661	11.2655
4	0.41062	0.83120	0.0342811	10.8850
5	0.39245	1.03503	0.0428171	10.6984
6	0.37377	1.22010	0.0507523	10.5851
7	0.35432	1.38821	0.0580688	10.5094
8	0.33388	1.53997	0.0647604	10.4557
9	0.31220	1.67578	0.0708180	10.4161
10	0.28896	1.79546	0.0762199	10.3862
11	0.26374	1.89860	0.0809417	10.3634
12	0.23588	1.98461	0.0849569	10.3460
13	0.20428	2.05326	0.0882575	10.3330
14	0.16683	2.10497	0.0908484	10.3234
15	0.11806	2.13911	0.0927242	10.3169
16	0.00000	2.16315	0.0933690	10.3122

THE RENOLDS NO. IS 0.47701807E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0015078 LB/IN<sup>2</sup> INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	5.0000
2	0.41354	0.13405	0.0124455	5.0000
3	0.44873	0.31907	0.0521661	11.5625
4	0.45875	0.60596	0.0345911	10.8820
5	0.41065	0.83150	0.0458171	10.6984
6	0.39242	1.03203	0.0501553	10.5821
7	0.37377	1.55010	0.0580888	10.5094
8	0.35435	1.38851	0.0647604	10.4557
9	0.33388	1.53997	0.0708180	10.4181
10	0.31550	1.67578	0.0765199	10.3885
11	0.58896	1.79546	0.0809477	10.3634
12	0.56374	1.89860	0.0844263	10.3460
13	0.53288	1.98491	0.0885275	10.3330
14	0.50458	5.02356	0.0908484	10.3534
15	0.16683	5.10497	0.0951545	10.3159
16	0.11006	5.13911	0.0933990	10.3155
	0.00000	5.16315		

THE REYNOLDS NO. IS 0.4701807E 03 .

THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 51.100 FEET, THE PRESSURE GRADIENT IS 0.0012543 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47503	0.14151	0.0052759	2.0000
2	0.44814	0.27183	0.0154927	2.0000
3	0.42532	0.54967	0.0251661	11.7636
4	0.40603	0.81228	0.0342811	11.1893
5	0.38748	1.03585	0.0428171	10.9273
6	0.36869	1.23533	0.0507523	10.7731
7	0.34929	1.41496	0.0580688	10.6713
8	0.32899	1.57632	0.0647604	10.5996
9	0.30753	1.72014	0.0708180	10.5469
10	0.28458	1.84660	0.0762199	10.5072
11	0.25970	1.95544	0.0809417	10.4770
12	0.23226	2.04613	0.0849569	10.4541
13	0.20116	2.11830	0.0882575	10.4368
14	0.16432	2.17254	0.0908484	10.4243
15	0.11638	2.20830	0.0927242	10.4157
16	0.00000	2.23270	0.0933690	10.4095

THE RENOLDS NO. IS 0.45933335E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 51.100 FEET, THE PRESSURE GRADIENT IS 0.0015243 LB\20 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CU FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.002529	5.0000
2	0.47503	0.14151	0.012435	5.0000
3	0.44814	0.27183	0.025186	11.7836
4	0.42535	0.24967	0.034581	11.1893
5	0.40603	0.41558	0.045817	10.9523
6	0.38748	1.03285	0.050253	10.7731
7	0.36869	1.53233	0.028068	10.6113
8	0.34953	1.41466	0.064760	10.5296
9	0.32899	1.27935	0.070819	10.5469
10	0.30753	1.35014	0.076519	10.5015
11	0.28458	1.84660	0.080415	10.4770
12	0.25970	1.42244	0.084439	10.4541
13	0.23556	5.04613	0.084525	10.4398
14	0.20119	5.11830	0.090848	10.4543
15	0.16435	5.17554	0.095545	10.4751
16	0.11938	5.50830	0.093360	10.4095
19	0.00000	5.53510		

THE REYNOLDS NO. IS 0.4293333E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0013239 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	2.0000
	0.47697	0.15290		
2			0.0154927	2.0000
	0.45316	0.29044		
3			0.0251661	2.0000
	0.42698	0.41962		
4			0.0342811	11.8804
	0.40330	0.71042		
5			0.0428171	11.4073
	0.38287	0.98832		
6			0.0507523	11.1528
	0.36329	1.22101		
7			0.0580688	10.9927
	0.34354	1.42494		
8			0.0647604	10.8824
	0.32315	1.60550		
9			0.0708180	10.8024
	0.30176	1.76492		
10			0.0762199	10.7427
	0.27900	1.90419		
11			0.0809417	10.6974
	0.25442	2.02352		
12			0.0849569	10.6632
	0.22736	2.12262		
13			0.0882575	10.6376
	0.19673	2.20103		
14			0.0908484	10.6190
	0.16045	2.25954		
15			0.0927242	10.6063
	0.11315	2.29788		
16			0.0933690	10.5974
	0.00000	2.32246		

THE RENOLDS NO. IS 0.43519652E 03 .

THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0013539 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052529	5.0000
2	0.47697	0.15520	0.0154957	5.0000
3	0.45316	0.52044	0.0521691	5.0000
4	0.42898	0.41995	0.0345811	11.8804
5	0.40370	0.71045	0.0458171	11.4073
6	0.38587	0.98835	0.0505253	11.1559
7	0.36359	1.55101	0.0580688	10.9957
8	0.34324	1.45404	0.0645904	10.8854
9	0.32312	1.60550	0.0708180	10.8054
10	0.30176	1.16495	0.0765199	10.7451
11	0.27900	1.90419	0.0809417	10.6974
12	0.25445	5.05325	0.0849299	10.6635
13	0.25336	5.15565	0.0885252	10.6376
14	0.19973	5.50103	0.0900484	10.6190
15	0.16045	5.55924	0.0955545	10.6093
16	0.11312	5.50798	0.0933690	10.5974
	0.00000	5.35546		

THE REYNOLDS NO. IS 0.4351925E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 102.300 FEET, THE PRESSURE GRADIENT IS 0.0013874 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.47851	0.16331	0.0052759	2.0000
2	0.45638	0.31138	0.0154927	2.0000
3	0.43274	0.44866	0.0251661	2.0000
4	0.40702	0.57554	0.0342811	2.0000
5	0.38284	0.87031	0.0428171	11.9539
6	0.36142	1.15662	0.0507523	11.5546
7	0.34082	1.39404	0.0580688	11.3200
8	0.32002	1.59912	0.0647604	11.1649
9	0.29846	1.77775	0.0708180	11.0547
10	0.27571	1.93243	0.0762199	10.9734
11	0.25127	2.06419	0.0809417	10.9123
12	0.22447	2.17323	0.0849569	10.8663
13	0.19423	2.25919	0.0882575	10.8321
14	0.15849	2.32288	0.0908484	10.8073
15	0.11199	2.36453	0.0927242	10.7905
16	0.00000	2.39002	0.0933690	10.7789

THE RENOLDS NO. IS 0.41526330E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 51 .

AT 105.300 FEET, THE PRESSURE GRADIENT IS 0.0013874 LB/50 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0055529	5.0000
2	0.47821	0.10331	0.0154957	5.0000
3	0.45638	0.31138	0.0521681	5.0000
4	0.43574	0.44866	0.0345811	5.0000
5	0.40505	0.55524	0.0458171	11.9539
6	0.38584	0.87031	0.0505553	11.5546
7	0.36145	1.15665	0.0580888	11.3500
8	0.34005	1.36404	0.0645604	11.1649
9	0.32005	1.59915	0.0708180	11.0247
10	0.30846	1.77775	0.0765199	10.9734
11	0.32571	1.93543	0.0804417	10.9153
12	0.32157	5.06419	0.0843269	10.8693
13	0.35447	5.17353	0.0895252	10.8351
14	0.19453	5.52919	0.0908484	10.8073
15	0.18849	5.35588	0.0951545	10.7905
16	0.11199	5.39453	0.0937990	10.7789
	0.00000	5.39005		

THE REYNOLDS NO. IS 0.4152430E 03 .

THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 22 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.0015177 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48108	0.18454	0.0052759	2.0000
2	0.46174	0.35417	0.0154927	2.0000
3	0.44134	0.51333	0.0251661	2.0000
4	0.41980	0.66059	0.0342811	2.0000
5	0.39691	0.79532	0.0428171	2.0000
6	0.37235	0.91722	0.0507523	2.0000
7	0.34659	1.09820	0.0580688	2.0000
8	0.32191	1.41530	0.0647604	11.7849
9	0.29835	1.66621	0.0708180	11.5816
10	0.27443	1.87407	0.0762199	11.4430
11	0.24935	2.04653	0.0809417	11.3425
12	0.22228	2.18681	0.0849569	11.2684
13	0.19205	2.29621	0.0882575	11.2142
14	0.15656	2.37555	0.0908484	11.1755
15	0.11060	2.42676	0.0927242	11.1494
16	0.00000	2.45595	0.0933690	11.1322

THE RENOLDS NO. IS 0.37961681E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.001517 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	2.0000
2	0.48108	0.18424	0.012425	2.0000
3	0.48174	0.32417	0.021081	2.0000
4	0.44134	0.21333	0.034581	2.0000
5	0.41980	0.66029	0.045817	2.0000
6	0.39691	0.72235	0.020723	2.0000
7	0.37232	0.91725	0.028088	2.0000
8	0.34429	1.09850	0.043604	11.1849
9	0.32191	1.41230	0.0708180	11.2816
10	0.29832	1.66921	0.0725199	11.4430
11	0.27443	1.81407	0.080917	11.3422
12	0.24932	2.04823	0.084229	11.2284
13	0.22528	2.16881	0.088222	11.2142
14	0.19202	2.29921	0.0908484	11.1722
15	0.12629	2.37222	0.0925242	11.1494
16	0.11080	2.42979	0.0933690	11.1322
	0.00000	2.42292		

THE REYNOLDS NO. IS 0.37961816 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 23 .

AT 204.700 FEET, THE PRESSURE GRADIENT IS 0.0016175 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48269	0.20103	0.0052759	2.0000
2	0.46505	0.38706	0.0154927	2.0000
3	0.44658	0.56261	0.0251661	2.0000
4	0.42724	0.72671	0.0342811	2.0000
5	0.40690	0.87858	0.0428171	2.0000
6	0.38542	1.01756	0.0507523	2.0000
7	0.36256	1.14315	0.0580688	2.0000
8	0.33804	1.25488	0.0647604	2.0000
9	0.31133	1.35296	0.0708180	2.0000
10	0.28354	1.59680	0.0762199	11.9697
11	0.25580	1.84303	0.0809417	11.8051
12	0.22700	2.03497	0.0849569	11.6878
13	0.19554	2.18108	0.0882575	11.6052
14	0.15912	2.28472	0.0908484	11.5478
15	0.11233	2.35000	0.0927242	11.5099
16	0.00000	2.38481	0.0933690	11.4857

THE RENOLDS NO. IS 0.35620469E 03 .

THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 53 .

AT 504.700 FEET, THE PRESSURE GRADIENT IS 0.001675 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0075159	5.0000
2	0.48589	0.50103	0.0124957	5.0000
3	0.46202	0.38704	0.0251691	5.0000
4	0.44828	0.26591	0.0345811	5.0000
5	0.43454	0.15971	0.0458171	5.0000
6	0.40690	0.87820	0.0201553	5.0000
7	0.38245	1.01726	0.0280688	5.0000
8	0.36529	1.14312	0.0441604	5.0000
9	0.33804	1.52488	0.0708180	5.0000
10	0.31133	1.32504	0.0425199	11.9997
11	0.58324	1.59690	0.0809417	11.9991
12	0.52200	1.84303	0.0849299	11.9978
13	0.55700	5.03497	0.0885252	11.9925
14	0.19224	5.16108	0.0908484	11.9978
15	0.15915	5.58475	0.0525245	11.9999
16	0.11573	5.32000	0.0333990	11.9927
	0.00000	5.38481		

THE REYNOLDS NO. IS 0.32650499E 03 .



THE AGE OF FLOW IS 2.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.0017128 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	2.0000
2	0.48397	0.21786	0.0154927	2.0000
3	0.46775	0.41933	0.0251661	2.0000
4	0.45085	0.61042	0.0342811	2.0000
5	0.43324	0.79005	0.0428171	2.0000
6	0.41487	0.95778	0.0507523	2.0000
7	0.39564	1.11316	0.0580688	2.0000
8	0.37542	1.25549	0.0647604	2.0000
9	0.35403	1.38431	0.0708180	2.0000
10	0.33122	1.49920	0.0762199	2.0000
11	0.30669	1.59992	0.0809417	2.0000
12	0.27998	1.68647	0.0849569	2.0000
13	0.25040	1.75872	0.0882575	2.0000
14	0.21678	1.81701	0.0908484	2.0000
15	0.17687	1.86241	0.0927242	2.0000
16	0.12482	1.89435	0.0933690	2.0000
	0.00000	1.90907		

THE RENOLDS NO. IS 0.33638912E 03 .



THE AGE OF FLOW IS 5.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 54 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.001758 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025729	5.0000
2	0.48397	0.51786	0.0124957	5.0000
3	0.46775	0.41933	0.0251661	5.0000
4	0.45082	0.61045	0.0345811	5.0000
5	0.43354	0.79002	0.0428171	5.0000
6	0.41487	0.92772	0.0507523	5.0000
7	0.39564	1.11716	0.0580689	5.0000
8	0.37545	1.25249	0.0647604	5.0000
9	0.35403	1.38431	0.0708180	5.0000
10	0.33155	1.49950	0.0765199	5.0000
11	0.30869	1.59995	0.0809417	5.0000
12	0.27998	1.68647	0.0844569	5.0000
13	0.25040	1.75875	0.0882575	5.0000
14	0.21978	1.81701	0.0908484	5.0000
15	0.17697	1.86541	0.0927545	5.0000
16	0.12495	1.89432	0.0933690	5.0000
	0.00000	1.90907		

THE REYNOLDS NO. IS 0.3363845E 03 .

THE AGE OF FLOW IS 2.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)		PRESSURE (LB/SQ IN)
0.000	0.00000	
0.100	0.00031	
0.300	0.00092	
0.700	0.00216	
1.500	0.00462	
3.100	0.00689	
6.300	0.01035	
12.700	0.01729	
25.500	0.03205	
51.100	0.06302	
102.300	0.13075	
204.700	0.28564	
409.500	0.63316	
819.100	1.33471	
1638.300	2.73780	
3276.700	5.54398	
6553.500	11.15634	
13107.100	22.38106	
26214.300	44.83050	
52428.699	89.72939	
104857.498	179.52715	
209715.096	359.12269	
419430.293	718.31377	
528000.000	904.26724	

WITH 528000.0 FT., THE DROP IN PRESSURE IS 904.2672 LB/SQ IN.

THE AGE OF FLOW IS 5.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LBS/20 IN)

0.0000	0.000
0.0001	0.100
0.0002	0.300
0.0005	0.700
0.0010	1.200
0.0020	3.100
0.0050	6.300
0.0100	12.700
0.0200	25.200
0.0500	51.100
0.1000	102.300
0.2000	204.700
0.5000	409.200
1.0000	819.100
2.0000	1638.300
5.0000	3276.700
10.0000	6553.200
20.0000	13107.100
50.0000	26214.300
100.0000	52428.600
200.0000	104857.400
500.0000	262127.000
1000.0000	524254.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 904.5015 LBS/20 IN.



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 19.100 FEET, THE PRESSURE GRADIENT IS 0.0010587 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48402	0.21724	0.0052759	12.8715
2	0.46779	0.41933	0.0154927	10.9938
3	0.45089	0.60990	0.0251661	10.6162
4	0.43327	0.78887	0.0342811	10.4538
5	0.41487	0.95588	0.0428171	10.3639
6	0.39560	1.11052	0.0507523	10.3073
7	0.37532	1.25255	0.0580688	10.2687
8	0.35388	1.38184	0.0647604	10.2411
9	0.33104	1.49798	0.0708180	10.2205
10	0.30650	1.60054	0.0762199	10.2050
11	0.27980	1.68898	0.0809417	10.1931
12	0.25026	1.76280	0.0849569	10.1840
13	0.21673	1.82231	0.0882575	10.1771
14	0.17694	1.86732	0.0908484	10.1721
15	0.12507	1.89717	0.0927242	10.1686
16	0.00000	1.92063	0.0933690	10.1661

THE RENOLDS NO. IS 0.54421233E 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 16 .

AT 10.100 FEET, THE PRESSURE GRADIENT IS 0.0010207 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	12.8712
2	0.48402	0.21724	0.012402	10.9939
3	0.46719	0.41933	0.021661	10.6162
4	0.42089	0.60990	0.034281	10.4238
5	0.43327	0.78887	0.042817	10.3939
6	0.41407	0.92288	0.020722	10.3073
7	0.32260	1.11022	0.028068	10.2637
8	0.32232	1.22229	0.064760	10.2411
9	0.32389	1.38184	0.070818	10.2202
10	0.33104	1.40798	0.075719	10.2020
11	0.30620	1.60024	0.080347	10.1931
12	0.27980	1.68998	0.094329	10.1840
13	0.22026	1.76280	0.082222	10.1771
14	0.21673	1.82231	0.090848	10.1721
15	0.17694	1.86732	0.092724	10.1689
16	0.12207	1.89717	0.043390	10.1691
	0.00000	1.92063		

THE REYNOLDS NO. IS 0.2445133E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 17 .

AT 25.500 FEET, THE PRESSURE GRADIENT IS 0.0010569 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48400	0.21685	0.0052759	13.8355
2	0.46776	0.41955	0.0154927	11.3267
3	0.45086	0.61031	0.0251661	10.8225
4	0.43325	0.78932	0.0342811	10.6057
5	0.41486	0.95632	0.0428171	10.4858
6	0.39560	1.11093	0.0507523	10.4103
7	0.37533	1.25293	0.0580688	10.3588
8	0.35389	1.38215	0.0647604	10.3219
9	0.33106	1.49822	0.0708180	10.2945
10	0.30652	1.60068	0.0762199	10.2737
11	0.27982	1.68901	0.0809417	10.2578
12	0.25028	1.76271	0.0849569	10.2457
13	0.21675	1.82213	0.0882575	10.2365
14	0.17695	1.86707	0.0908484	10.2298
15	0.12508	1.89689	0.0927242	10.2252
16	0.00000	1.92039	0.0933690	10.2218

THE RENOLDS NO. IS 0.54512397E 03 .



THE MEMORANDUM NO. 12 OF 24213334E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.0000	1.2503	0.043360	10.5518
2	0.1508	1.8688	0.045154	10.5525
3	0.1769	1.8970	0.045254	10.5538
4	0.2165	1.8513	0.045252	10.5389
5	0.2508	1.7651	0.045252	10.5389
6	0.2798	1.6801	0.045254	10.5451
7	0.3109	1.4855	0.045254	10.5445
8	0.3538	1.3812	0.045254	10.5419
9	0.3753	1.5259	0.045254	10.5389
10	0.3920	1.1109	0.045254	10.5389
11	0.4148	0.9265	0.045254	10.5419
12	0.4335	0.7895	0.045254	10.5428
13	0.4508	0.6101	0.045254	10.5428
14	0.4676	0.4125	0.045254	10.5428
15	0.4840	0.5189	0.045254	10.5428
16	0.5000	0.0000	0.045254	10.5428

AT 52.500 FEET, THE PRESSURE GRADIENT IS 0.0010589 LBS/20 INCH.

THE INCREMENT NUMBER IN LENGTH IS 16 .

THE AGE OF FLOW IS 10.0000 MIN.

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.0010544 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48388	0.21520	0.0052759	15.7834
2	0.46759	0.41934	0.0154927	11.9954
3	0.45069	0.61078	0.0251661	11.2356
4	0.43308	0.79015	0.0342811	10.9097
5	0.41471	0.95736	0.0428171	10.7296
6	0.39546	1.11215	0.0507523	10.6162
7	0.37521	1.25428	0.0580688	10.5389
8	0.35378	1.38357	0.0647604	10.4835
9	0.33096	1.49962	0.0708180	10.4423
10	0.30644	1.60201	0.0762199	10.4111
11	0.27976	1.69022	0.0809417	10.3872
12	0.25024	1.76376	0.0849569	10.3690
13	0.21671	1.82306	0.0882575	10.3553
14	0.17694	1.86791	0.0908484	10.3452
15	0.12508	1.89773	0.0927242	10.3383
16	0.00000	1.92132	0.0933690	10.3332

THE RENOLDS NO. IS 0.54641138E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 18 .

AT 38.300 FEET, THE PRESSURE GRADIENT IS 0.001054 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	12.7834
2	0.48388	0.21250	0.012432	11.9324
3	0.44229	0.41934	0.022181	11.5328
4	0.42069	0.61078	0.034581	10.9032
5	0.43308	0.79012	0.045811	10.7539
6	0.41471	0.92736	0.050723	10.6125
7	0.39246	1.11212	0.058088	10.5389
8	0.37221	1.25458	0.064204	10.4832
9	0.35378	1.38321	0.070818	10.4423
10	0.33098	1.49995	0.076519	10.4111
11	0.30644	1.60501	0.080917	10.3815
12	0.27976	1.69052	0.084989	10.3590
13	0.25024	1.76376	0.088222	10.3223
14	0.21871	1.82300	0.090848	10.3422
15	0.17694	1.86791	0.092545	10.3383
16	0.12208	1.89773	0.093389	10.3332
	0.00000	1.92132		

THE REYNOLDS NO. IS 0.244138E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 19 .

AT 51.100 FEET, THE PRESSURE GRADIENT IS 0.0010532 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48368	0.21255	0.0052759	17.7654
2	0.46728	0.41838	0.0154927	12.6690
3	0.45035	0.61088	0.0251661	11.6494
4	0.43275	0.79095	0.0342811	11.2139
5	0.41439	0.95869	0.0428171	10.9733
6	0.39515	1.11392	0.0507523	10.8219
7	0.37492	1.25642	0.0580688	10.7188
8	0.35352	1.38594	0.0647604	10.6448
9	0.33072	1.50217	0.0708180	10.5899
10	0.30622	1.60465	0.0762199	10.5483
11	0.27956	1.69287	0.0809417	10.5165
12	0.25007	1.76638	0.0849569	10.4923
13	0.21657	1.82565	0.0882575	10.4740
14	0.17682	1.87049	0.0908484	10.4606
15	0.12501	1.90032	0.0927242	10.4514
16	0.00000	1.92400	0.0933690	10.4445

THE RENOLDS NO. IS 0.54704881E 03 .

THE REYNOLDS NO. IS 0.2470481E 03 .

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
16	0.00000	1.25400	0.003390	10.4442
15	0.12501	1.20035	0.0021545	10.4214
14	0.15002	1.25049	0.0008484	10.4802
13	0.21823	1.25202	0.0008252	10.4140
12	0.22003	1.18030	0.0005252	10.4140
11	0.25028	1.04583	0.0043204	10.4353
10	0.25025	1.00402	0.0000013	10.2102
9	0.30035	1.20213	0.0102199	10.2483
8	0.32322	1.38204	0.0108180	10.2893
7	0.37442	1.22042	0.0043004	10.0448
6	0.39212	1.11302	0.0020223	10.0219
5	0.41439	0.92809	0.0020223	10.0219
4	0.43232	0.73002	0.0020223	10.0219
3	0.42032	0.61088	0.0042011	11.2139
2	0.46728	0.41028	0.0021001	11.0494
1	0.48309	0.21222	0.0124923	12.0030
	0.20000	0.00000	0.0022229	12.7024

AT 21.100 FEET, THE PRESSURE GRADIENT IS 0.0010232 LB/20 IN/FT.

THE INCREMENT NUMBER IN LENGTH IS 19 .

THE AGE OF FLOW IS 10.0000 MIN.



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0010490 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48359	0.21185	0.0052759	10.0000
2	0.46710	0.41668	0.0154927	14.0110
3	0.45011	0.61019	0.0251661	12.4729
4	0.43249	0.79113	0.0342811	11.8192
5	0.41412	0.95961	0.0428171	11.4587
6	0.39489	1.11548	0.0507523	11.2319
7	0.37467	1.25843	0.0580688	11.0775
8	0.35329	1.38822	0.0647604	10.9667
9	0.33052	1.50456	0.0708180	10.8845
10	0.30604	1.60705	0.0762199	10.8222
11	0.27941	1.69516	0.0809417	10.7746
12	0.24993	1.76846	0.0849569	10.7384
13	0.21645	1.82757	0.0882575	10.7110
14	0.17673	1.87230	0.0908484	10.6910
15	0.12493	1.90214	0.0927242	10.6772
16	0.00000	1.92597	0.0933690	10.6668

THE RENOLDS NO. IS 0.54926498E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 76.700 FEET, THE PRESSURE GRADIENT IS 0.0010490 LB\25 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CU FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025729	10.0000
2	0.40329	0.21102	0.0124927	14.0110
3	0.60710	0.41668	0.0251661	12.4720
4	0.82011	0.61019	0.0342811	11.8132
5	0.93249	0.79113	0.0428171	11.4287
6	0.94412	0.92961	0.0507223	11.2319
7	0.39480	1.11246	0.0580688	11.0722
8	0.37467	1.22043	0.0647804	10.9227
9	0.32329	1.30822	0.0708180	10.8842
10	0.33022	1.20426	0.0742199	10.8222
11	0.30604	1.60702	0.0809417	10.7746
12	0.27941	1.69216	0.0849299	10.7384
13	0.24993	1.76846	0.0822222	10.7110
14	0.21642	1.82727	0.0808484	10.6910
15	0.17673	1.82230	0.0822242	10.6722
16	0.12493	1.90214	0.0833690	10.6628
	0.00000	1.92297		

THE REYNOLDS NO. IS 0.24259496 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 102.300 FEET, THE PRESSURE GRADIENT IS 0.0010472 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.0000
2	0.48344	0.20954	0.0154927	15.3753
3	0.46677	0.41274	0.0251661	13.3063
4	0.44968	0.60788	0.0342811	12.4287
5	0.43200	0.79040	0.0428171	11.9460
6	0.41361	0.96026	0.0507523	11.6427
7	0.39439	1.11737	0.0580688	11.4363
8	0.37419	1.26132	0.0647604	11.2884
9	0.35283	1.39186	0.0708180	11.1787
10	0.33009	1.50876	0.0762199	11.0957
11	0.30564	1.61160	0.0809417	11.0323
12	0.27905	1.69990	0.0849569	10.9841
13	0.24961	1.77327	0.0882575	10.9477
14	0.21618	1.83243	0.0908484	10.9209
15	0.17651	1.87719	0.0927242	10.9026
16	0.12479	1.90711	0.0933690	10.8887
	0.00000	1.93113		

THE RENOLDS NO. IS 0.55019418E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 11 .

AT 105.300 FEET, THE PRESSURE GRADIENT IS 0.0010475 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	10.0000
2	0.48344	0.20994	0.0124925	12.3753
3	0.76687	0.41574	0.021661	13.3063
4	0.94988	0.60788	0.0345811	15.4587
5	0.93500	0.79040	0.0458171	17.9420
6	0.61361	0.98050	0.0207523	17.6457
7	0.39439	1.1737	0.0200988	17.4323
8	0.37419	1.26132	0.0047004	17.5884
9	0.35583	1.34186	0.0708180	17.1787
10	0.33009	1.20876	0.0705199	17.0927
11	0.30564	1.61160	0.0809477	17.0353
12	0.52902	1.69990	0.0844269	10.9841
13	0.54961	1.77357	0.0875252	10.9477
14	0.51618	1.83543	0.0409484	10.9509
15	0.17621	1.87719	0.0457545	10.9050
16	0.15479	1.90711	0.0433690	10.8887
	0.00000	1.93113		

THE REYNOLDS NO. IS 0.25019418E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 22 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.0010423 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48343	0.20964	0.0052759	10.0000
2	0.46660	0.40676	0.0154927	18.1168
3	0.44928	0.60240	0.0251661	14.9806
4	0.43147	0.78707	0.0342811	13.6479
5	0.41300	0.95926	0.0428171	12.9186
6	0.39375	1.11860	0.0507523	12.4616
7	0.37355	1.26428	0.0580688	12.1512
8	0.35221	1.39610	0.0647604	11.9293
9	0.32951	1.51389	0.0708180	11.7649
10	0.30511	1.61731	0.0762199	11.6406
11	0.27856	1.70590	0.0809417	11.5458
12	0.24918	1.77934	0.0849569	11.4737
13	0.21580	1.83854	0.0882575	11.4194
14	0.17619	1.88335	0.0908484	11.3795
15	0.12453	1.91342	0.0927242	11.3520
16	0.00000	1.93776	0.0933690	11.3312

THE RENOLDS NO. IS 0.55277032E 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 55 .

AT 153.200 FEET, THE PRESSURE GRADIENT IS 0.0010453 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025250	10.0000
2	0.48343	0.20364	0.0124434	18.1158
3	0.46660	0.40676	0.0221661	14.2806
4	0.44328	0.60540	0.0345811	13.6479
5	0.43147	0.78707	0.0458171	15.9186
6	0.41300	0.92956	0.0507523	15.4515
7	0.39375	1.11860	0.0580688	15.1515
8	0.37322	1.26458	0.0647604	11.2503
9	0.35251	1.36610	0.0708180	11.3649
10	0.33221	1.51389	0.0752199	11.6406
11	0.30211	1.61731	0.0809417	11.2428
12	0.27826	1.70220	0.0849269	11.4737
13	0.24918	1.77934	0.0825252	11.4134
14	0.21280	1.83824	0.0908484	11.3792
15	0.17619	1.88332	0.0921245	11.3220
16	0.15423	1.91343	0.0933690	11.3315
	0.00000	1.93776		

THE REYNOLDS NO. IS 0.2227032E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 23 .

AT 204.700 FEET, THE PRESSURE GRADIENT IS 0.0010389 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.0000
2	0.48336	0.20875	0.0154927	10.0000
3	0.46642	0.40324	0.0251661	16.6743
4	0.44892	0.59663	0.0342811	14.8764
5	0.43095	0.78281	0.0428171	13.8946
6	0.41239	0.95733	0.0507523	13.2809
7	0.39309	1.11912	0.0580688	12.8652
8	0.37289	1.26677	0.0647604	12.5685
9	0.35157	1.40010	0.0708180	12.3493
10	0.32889	1.51905	0.0762199	12.1837
11	0.30453	1.62328	0.0809417	12.0575
12	0.27803	1.71234	0.0849569	11.9616
13	0.24870	1.78605	0.0882575	11.8895
14	0.21539	1.84546	0.0908484	11.8364
15	0.17584	1.89045	0.0927242	11.7999
16	0.12428	1.92073	0.0933690	11.7721
	0.00000	1.94542		

THE REYNOLDS NO. IS 0.55455625E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 53 .

AT 504.700 FEET, THE PRESSURE GRADIENT IS 0.0010389 LB/IN<sup>2</sup> IN WT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0055559	10.0000
2	0.48338	0.50852	0.0154957	10.0000
3	0.46645	0.40354	0.0521661	10.0743
4	0.44895	0.52663	0.0345811	14.8124
5	0.43092	0.78581	0.0458171	13.8946
6	0.41539	0.92733	0.0507523	13.5809
7	0.39909	1.11915	0.0500688	15.8825
8	0.37589	1.56677	0.0647604	15.5682
9	0.35127	1.40010	0.0708180	15.3493
10	0.35889	1.51905	0.0765199	15.1837
11	0.30423	1.65358	0.0606417	15.0252
12	0.57803	1.71534	0.0849269	11.9619
13	0.54870	1.78905	0.0885252	11.8832
14	0.51539	1.84246	0.0908484	11.8324
15	0.17584	1.19045	0.0955545	11.7999
16	0.15458	1.95073	0.0933690	11.7751
	0.00000	1.94245		

THE REYNOLDS NO. IS 0.5242265E 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.0010342 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48325	0.20754	0.0052759	10.0000
2	0.46622	0.40046	0.0154927	10.0000
3	0.44846	0.58562	0.0251661	10.0000
4	0.43018	0.77244	0.0342811	17.3660
5	0.41140	0.95105	0.0428171	15.8618
6	0.39197	1.11774	0.0507523	14.9246
7	0.37172	1.26944	0.0580688	14.2928
8	0.35040	1.40607	0.0647604	13.8441
9	0.32775	1.52760	0.0708180	13.5137
10	0.30346	1.63375	0.0762199	13.2648
11	0.27705	1.72404	0.0809417	13.0757
12	0.24782	1.79854	0.0849569	12.9324
13	0.21462	1.85862	0.0882575	12.8247
14	0.17522	1.90416	0.0908484	12.7454
15	0.12386	1.93496	0.0927242	12.6908
16	0.00000	1.96038	0.0933690	12.6488

THE RENOLDS NO. IS 0.55710531E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.0010345 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025729	10.0000
2	0.48352	0.20124	0.0124957	10.0000
3	0.46252	0.40048	0.0521661	10.0000
4	0.44846	0.58282	0.0345811	11.3660
5	0.43018	0.77544	0.0458171	12.8819
6	0.41140	0.92102	0.0201253	14.2542
7	0.39197	1.11774	0.0280688	14.5058
8	0.37172	1.26944	0.0647004	13.8441
9	0.35040	1.40207	0.0709180	13.2131
10	0.32772	1.52760	0.0725199	13.5649
11	0.30346	1.63372	0.0809417	13.0127
12	0.27702	1.72404	0.0644269	12.2324
13	0.24782	1.79824	0.0882572	12.8247
14	0.21462	1.82662	0.0908484	12.7424
15	0.17252	1.90410	0.0937542	12.6908
16	0.12382	1.93498	0.0933990	12.6489
	0.00000	1.96038		

THE REYNOLDS NO. IS 0.2271031E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 409.500 FEET, THE PRESSURE GRADIENT IS 0.0010307 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0000
	0.48318	0.20664		
2			0.0154927	10.0000
	0.46606	0.39860		
3			0.0251661	10.0000
	0.44818	0.58035		
4			0.0342811	19.8895
	0.42966	0.76221		
5			0.0428171	17.8491
	0.41064	0.94366		
6			0.0507523	16.5756
	0.39108	1.11462		
7			0.0580688	15.7207
	0.37075	1.27011		
8			0.0647604	15.1166
	0.34941	1.40996		
9			0.0708180	14.6732
	0.32678	1.53412		
10			0.0762199	14.3402
	0.30252	1.64229		
11			0.0809417	14.0878
	0.27617	1.73398		
12			0.0849569	13.8970
	0.24702	1.80946		
13			0.0882575	13.7537
	0.21391	1.87038		
14			0.0908484	13.6482
	0.17464	1.91661		
15			0.0927242	13.5754
	0.12344	1.94799		
16			0.0933690	13.5193
	0.00000	1.97410		

THE RENOLDS NO. IS 0.55900419E 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 52 .

AT 409.200 FEET, THE PRESSURE GRADIENT IS 0.0010307 LBS/20 INCH.

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	10.0000
2	0.48318	0.20864	0.0124957	10.0000
3	0.48806	0.38860	0.0251861	10.0000
4	0.44818	0.28032	0.0345311	19.8892
5	0.45366	0.16221	0.0428171	17.8491
6	0.41064	0.24368	0.0207253	16.2729
7	0.39108	1.11442	0.0280288	12.1507
8	0.37072	1.27011	0.0447604	12.1166
9	0.34941	1.40996	0.0708180	14.6732
10	0.32978	1.23472	0.0725199	14.3402
11	0.30222	1.64229	0.0809477	14.0878
12	0.27077	1.13398	0.0849269	13.8970
13	0.24702	1.80946	0.0885252	13.7237
14	0.21391	1.87038	0.0909484	13.6482
15	0.17464	1.91661	0.0927242	13.2724
16	0.12344	1.94799	0.0933600	13.2193
	0.00000	1.97410		

THE REYNOLDS NO. IS 0.22900416 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 26 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.0010342 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48325	0.20755	0.0052759	10.0000
2	0.46622	0.40044	0.0154927	10.0000
3	0.44844	0.58297	0.0251661	10.0000
4	0.42989	0.75409	0.0342811	10.0000
5	0.41044	0.91336	0.0428171	10.0000
6	0.39025	1.08669	0.0507523	19.9367
7	0.36947	1.25421	0.0580688	18.6044
8	0.34788	1.40426	0.0647604	17.6687
9	0.32512	1.53693	0.0708180	16.9884
10	0.30084	1.65198	0.0762199	16.4810
11	0.27453	1.74890	0.0809417	16.0987
12	0.24548	1.82828	0.0849569	15.8112
13	0.21253	1.89240	0.0882575	15.5957
14	0.17348	1.94112	0.0908484	15.4369
15	0.12262	1.97424	0.0927242	15.3273
16	0.00000	2.00187	0.0933690	15.2420

THE RENOLDS NO. IS 0.55709016E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.0010345 LB/IN<sup>2</sup> INFT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	10.0000
2	0.48322	0.20222	0.0124922	10.0000
3	0.46622	0.40044	0.0221661	10.0000
4	0.44844	0.28292	0.0342811	10.0000
5	0.42989	0.22409	0.0428121	10.0000
6	0.41044	0.21336	0.0428121	10.0000
7	0.39022	1.08669	0.0280688	18.6044
8	0.36942	1.22421	0.0428121	12.6682
9	0.34788	1.40426	0.0280688	16.9084
10	0.32212	1.23663	0.0280688	16.4810
11	0.30094	1.62198	0.0280688	16.0082
12	0.27422	1.24690	0.0280688	12.8112
13	0.24244	1.82828	0.0280688	12.2222
14	0.21522	1.82440	0.0280688	12.4282
15	0.17348	1.90112	0.0280688	12.3222
16	0.15282	1.92424	0.0280688	12.2420
17	0.00000	2.00182	0.0280688	12.2420

THE REYNOLDS NO. IS 0.227090182 03 .

THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 27 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0010475 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	10.0000
	0.48354	0.21098		
2			0.0154927	10.0000
	0.46680	0.40734		
3			0.0251661	10.0000
	0.44936	0.59336		
4			0.0342811	10.0000
	0.43118	0.76797		
5			0.0428171	10.0000
	0.41217	0.93061		
6			0.0507523	10.0000
	0.39223	1.08080		
7			0.0580688	10.0000
	0.37118	1.21850		
8			0.0647604	10.0000
	0.34892	1.35443		
9			0.0708180	19.3402
	0.32553	1.50326		
10			0.0762199	18.6360
	0.30084	1.63123		
11			0.0809417	18.1114
	0.27428	1.73836		
12			0.0849569	17.7198
	0.24509	1.82526		
13			0.0882575	17.4274
	0.21209	1.89525		
14			0.0908484	17.2123
	0.17306	1.94841		
15			0.0927242	17.0638
	0.12230	1.98434		
16			0.0933690	16.9480
	0.00000	2.01383		

THE RENOLDS NO. IS 0.55002389E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 57 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0010475 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	10.0000
2	0.48324	0.51098	0.0124027	10.0000
3	0.46880	0.40734	0.0251681	10.0000
4	0.44936	0.29336	0.0345811	10.0000
5	0.43118	0.16197	0.0458171	10.0000
6	0.41517	0.93081	0.0507553	10.0000
7	0.39553	1.08080	0.0580688	10.0000
8	0.37118	1.51820	0.0647204	10.0000
9	0.34895	1.32443	0.0708180	19.3405
10	0.32523	1.20759	0.0765199	18.6360
11	0.30084	1.43153	0.0809417	18.1114
12	0.27458	1.73836	0.0849289	17.7193
13	0.24509	1.92529	0.0885272	17.4574
14	0.21509	1.89252	0.0908484	17.5153
15	0.17306	1.24841	0.0925245	17.0938
16	0.12530	1.08434	0.0933990	16.9480
	0.00000	5.01383		

THE RECORDS NO. 12 0.2500389E 03 .



THE AGE OF FLOW IS 10.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 28 .

AT 1228.700 FEET, THE PRESSURE GRADIENT IS 0.0010668 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	10.0000
2	0.48391	0.21619	0.0154927	10.0000
3	0.46760	0.41744	0.0251661	10.0000
4	0.45063	0.60846	0.0342811	10.0000
5	0.43297	0.78812	0.0428171	10.0000
6	0.41456	0.95586	0.0507523	10.0000
7	0.39528	1.11120	0.0580688	10.0000
8	0.37501	1.25385	0.0647604	10.0000
9	0.35358	1.38379	0.0708180	10.0000
10	0.33076	1.50060	0.0762199	10.0000
11	0.30624	1.60382	0.0809417	10.0000
12	0.27959	1.69294	0.0849569	10.0000
13	0.25011	1.76742	0.0882575	10.0000
14	0.21665	1.82747	0.0908484	10.0000
15	0.17697	1.87290	0.0927242	10.0000
16	0.12531	1.90301	0.0933690	10.0000
	0.00000	1.92654		

THE RENOLDS NO. IS 0.54005294E 03 .

THE REYNOLDS NO. IS 0.2400254E 03 .

NO.	RADIAL INCREMENT (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.25824	0.0033900	10.0000
2	0.12231	1.20301	0.0021242	10.0000
3	0.12692	1.82242	0.0080484	10.0000
4	0.21692	1.82242	0.0080484	10.0000
5	0.22011	1.26242	0.0082222	10.0000
6	0.22011	1.26242	0.0082222	10.0000
7	0.30254	1.60382	0.0080412	10.0000
8	0.30254	1.60382	0.0080412	10.0000
9	0.33026	1.20080	0.0050199	10.0000
10	0.33026	1.20080	0.0050199	10.0000
11	0.40254	1.60382	0.0080412	10.0000
12	0.40254	1.60382	0.0080412	10.0000
13	0.52011	1.26242	0.0082222	10.0000
14	0.52011	1.26242	0.0082222	10.0000
15	0.51692	1.82242	0.0080484	10.0000
16	0.51692	1.82242	0.0080484	10.0000
17	0.60382	1.60382	0.0080412	10.0000
18	0.60382	1.60382	0.0080412	10.0000
19	0.60382	1.60382	0.0080412	10.0000
20	0.60382	1.60382	0.0080412	10.0000
21	0.60382	1.60382	0.0080412	10.0000
22	0.60382	1.60382	0.0080412	10.0000
23	0.60382	1.60382	0.0080412	10.0000
24	0.60382	1.60382	0.0080412	10.0000
25	0.60382	1.60382	0.0080412	10.0000
26	0.60382	1.60382	0.0080412	10.0000
27	0.60382	1.60382	0.0080412	10.0000
28	0.60382	1.60382	0.0080412	10.0000
29	0.60382	1.60382	0.0080412	10.0000
30	0.60382	1.60382	0.0080412	10.0000
31	0.60382	1.60382	0.0080412	10.0000
32	0.60382	1.60382	0.0080412	10.0000
33	0.60382	1.60382	0.0080412	10.0000
34	0.60382	1.60382	0.0080412	10.0000
35	0.60382	1.60382	0.0080412	10.0000
36	0.60382	1.60382	0.0080412	10.0000
37	0.60382	1.60382	0.0080412	10.0000
38	0.60382	1.60382	0.0080412	10.0000
39	0.60382	1.60382	0.0080412	10.0000
40	0.60382	1.60382	0.0080412	10.0000
41	0.60382	1.60382	0.0080412	10.0000
42	0.60382	1.60382	0.0080412	10.0000
43	0.60382	1.60382	0.0080412	10.0000
44	0.60382	1.60382	0.0080412	10.0000
45	0.60382	1.60382	0.0080412	10.0000
46	0.60382	1.60382	0.0080412	10.0000
47	0.60382	1.60382	0.0080412	10.0000
48	0.60382	1.60382	0.0080412	10.0000
49	0.60382	1.60382	0.0080412	10.0000
50	0.60382	1.60382	0.0080412	10.0000

AT 1228.700 FEET, THE PRESSURE GRADIENT IS 0.0010688 LB/IN<sup>2</sup> INFT.

THE INCREMENT NUMBER IN LENGTH IS 28 .

THE AGE OF FLOW IS 10.0000 MIN.



THE AGE OF FLOW IS 10.0000 MIN.

THE MEASUREMENT		DISTANCE FROM ENTRANCE (FEET)	PRESSURE (LB/SQ IN)
AT	0.000	0.00000	
	0.100	0.00031	
	0.300	0.00092	
	0.700	0.00216	
1	1.500	0.00462	
	3.100	0.00689	
	6.300	0.01035	
	12.700	0.01729	
2	25.500	0.03096	
	51.100	0.05796	
3	102.300	0.11168	
	204.700	0.21844	
4	409.500	0.43029	
	819.100	0.85457	
5	1638.300	1.72589	
	3276.700	3.47380	
6	6553.500	6.96964	
	13107.100	13.96132	
7	26214.300	27.94466	
	52428.699	55.91136	
8	104857.498	111.84475	
	209715.096	223.71153	
9	419430.293	447.44510	
	528000.000	563.27213	
10			
11			
12			
13			
14			
15			
16			
17			
18			

WITH 528000.0 FT., THE DROP IN PRESSURE IS 563.2721 LB/SQ IN.

THE PRESSURE DROP IS 563.2721 LB/SQ IN.



THE AGE OF FLOW IS 10.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LB/IN<sup>2</sup>)

0.0000	0.000
0.0001	0.100
0.0002	0.300
0.0005	0.700
0.0010	1.200
0.0020	3.100
0.0035	6.300
0.0125	15.700
0.0300	52.200
0.0500	51.100
0.1100	102.300
0.2100	204.700
0.4300	409.200
0.8200	819.100
1.5200	1638.300
3.4300	3276.700
8.0000	6553.200
13.0000	13107.100
27.0000	26214.300
52.0000	52428.600
111.0000	104857.400
223.0000	209715.000
447.0000	419430.000
893.0000	838860.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 263.251 LB/IN<sup>2</sup>.

THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 21 .

AT 102.300 FEET, THE PRESSURE GRADIENT IS 0.0010365 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	24.9867
	0.48446	0.22305		
2			0.0154927	15.2849
	0.46836	0.41684		
3			0.0251661	13.3039
	0.45137	0.60778		
4			0.0342811	12.4339
	0.43371	0.78737		
5			0.0428171	11.9524
	0.41530	0.95488		
6			0.0507523	11.6490
	0.39603	1.10998		
7			0.0580688	11.4423
	0.37577	1.25214		
8			0.0647604	11.2941
	0.35434	1.38109		
9			0.0708180	11.1841
	0.33151	1.49657		
10			0.0762199	11.1008
	0.30697	1.59817		
11			0.0809417	11.0372
	0.28026	1.68540		
12			0.0849569	10.9888
	0.25070	1.75792		
13			0.0882575	10.9523
	0.21711	1.81643		
14			0.0908484	10.9254
	0.17725	1.86071		
15			0.0927242	10.9070
	0.12528	1.89036		
16			0.0933690	10.8930
	0.00000	1.91433		

THE RENOLDS NO. IS 0.55585812E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 51 .

AT 105.300 FEET, THE PRESSURE GRADIENT IS 0.0010965 LB\20 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CU FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	24.9897
2	0.48446	0.25305	0.0124927	12.2849
3	0.46836	0.41684	0.0521661	13.3039
4	0.45137	0.40718	0.0345811	15.4339
5	0.43371	0.38737	0.0458171	11.9254
6	0.41530	0.37488	0.0507253	11.6490
7	0.39603	1.10998	0.0580688	11.4453
8	0.37577	1.25214	0.0447404	11.2941
9	0.35434	1.38109	0.0708180	11.1841
10	0.33121	1.49957	0.0795199	11.1006
11	0.30697	1.29817	0.0809477	11.0375
12	0.28056	1.68640	0.0849269	10.9888
13	0.25010	1.75795	0.0885252	10.9253
14	0.21711	1.81643	0.0908484	10.9254
15	0.17752	1.86071	0.0925245	10.9070
16	0.15258	1.89036	0.0933990	10.8930
17	0.00000	1.91433		

THE REYNOLDS NO. IS 0.2528215E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 22 .

AT 153.500 FEET, THE PRESSURE GRADIENT IS 0.0010271 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48490	0.22965	0.0052759	32.1700
2	0.46887	0.41143	0.0154927	17.9218
3	0.45169	0.60174	0.0251661	14.9757
4	0.43391	0.78249	0.0342811	13.6592
5	0.41541	0.95149	0.0428171	12.9323
6	0.39610	1.10804	0.0507523	12.4751
7	0.37581	1.25116	0.0580688	12.1640
8	0.35437	1.38072	0.0647604	11.9413
9	0.33154	1.49649	0.0708180	11.7763
10	0.30700	1.59813	0.0762199	11.6515
11	0.28029	1.68515	0.0809417	11.5562
12	0.25073	1.75737	0.0849569	11.4837
13	0.21713	1.81564	0.0882575	11.4291
14	0.17726	1.85977	0.0908484	11.3890
15	0.12526	1.88947	0.0927242	11.3613
16	0.00000	1.91375	0.0933690	11.3403

THE RENOLDS NO. IS 0.56094179E 03 .

THE REYNOLDS NO. IS 0.5604170E 03 .

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.00000	1.91375	0.003300	11.3403
2	0.15250	1.88047	0.0051545	11.3813
3	0.17750	1.85077	0.0057500	11.3890
4	0.21713	1.81204	0.0080484	11.3890
5	0.21713	1.81204	0.0080484	11.3890
6	0.25073	1.75737	0.0085257	11.4501
7	0.25073	1.75737	0.0085257	11.4501
8	0.30700	1.59813	0.0090047	11.5505
9	0.30700	1.59813	0.0090047	11.5505
10	0.32437	1.38075	0.007400	11.5505
11	0.32437	1.38075	0.007400	11.5505
12	0.37281	1.52110	0.007400	11.5505
13	0.37281	1.52110	0.007400	11.5505
14	0.43331	0.78249	0.034581	13.0295
15	0.43331	0.78249	0.034581	13.0295
16	0.45100	0.60174	0.052100	14.257
17	0.45100	0.60174	0.052100	14.257
18	0.48440	0.55005	0.014957	17.0319
19	0.50000	0.00000	0.005150	35.1700

AT 123.500 FEET, THE PRESSURE GRADIENT IS 0.001051 LB/SD IN/FT.

THE INCREMENT NUMBER IN LENGTH IS 55 .

THE AGE OF FLOW IS 20.0000 MIN.



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 23 .

AT 204.700 FEET, THE PRESSURE GRADIENT IS 0.0010159 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	39.0036
2	0.48541	0.23755	0.0154927	20.5298
3	0.46966	0.41145	0.0251661	16.6629
4	0.45242	0.59711	0.0342811	14.8945
5	0.43453	0.77734	0.0428171	13.9176
6	0.41595	0.94697	0.0507523	13.3040
7	0.39658	1.10428	0.0580688	12.8873
8	0.37626	1.24782	0.0647604	12.5896
9	0.35479	1.37754	0.0708180	12.3692
10	0.33194	1.49328	0.0762199	12.2027
11	0.30737	1.59468	0.0809417	12.0758
12	0.28064	1.68128	0.0849569	11.9794
13	0.25103	1.75308	0.0882575	11.9067
14	0.21740	1.81104	0.0908484	11.8532
15	0.17746	1.85496	0.0927242	11.8164
16	0.12539	1.88467	0.0933690	11.7882
	0.00000	1.90926		

THE RENOLDS NO. IS 0.56712463E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 53 .

AT 204.700 FEET, THE PRESSURE GRADIENT IS 0.0010192 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025252	39.0039
2	0.48241	0.23722	0.0124927	20.2298
3	0.48986	0.41142	0.0251661	16.6623
4	0.42242	0.20711	0.0342811	14.8942
5	0.43423	0.17734	0.0428171	13.9179
6	0.41292	0.09697	0.0207223	13.3049
7	0.39928	1.10428	0.0280688	12.8813
8	0.37626	1.24782	0.0447604	12.2899
9	0.32479	1.37724	0.0708180	12.3692
10	0.33194	1.49328	0.0762199	12.5027
11	0.30737	1.23468	0.0809477	12.0728
12	0.28094	1.68128	0.0849269	11.9794
13	0.22103	1.72308	0.0882222	11.9027
14	0.21740	1.81104	0.0908484	11.8232
15	0.17746	1.82499	0.0425242	11.8124
16	0.12239	1.98497	0.0933990	11.7882
	0.00000	1.90929		

THE REYNOLDS NO. IS 0.2671243E 03 .

THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.0009956 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	52.2270
	0.48571	0.24210		
2			0.0154927	25.6318
	0.47036	0.42216		
3			0.0251661	20.0236
	0.45335	0.59607		
4			0.0342811	17.3800
	0.43541	0.77235		
5			0.0428171	15.8995
	0.41676	0.94206		
6			0.0507523	14.9690
	0.39734	1.09971		
7			0.0580688	14.3389
	0.37697	1.24340		
8			0.0647604	13.8899
	0.35547	1.37308		
9			0.0708180	13.5583
	0.33259	1.48852		
10			0.0762199	13.3083
	0.30799	1.58934		
11			0.0809417	13.1181
	0.28122	1.67505		
12			0.0849569	12.9738
	0.25156	1.74609		
13			0.0882575	12.8650
	0.21786	1.80355		
14			0.0908484	12.7849
	0.17784	1.84718		
15			0.0927242	12.7296
	0.12565	1.87695		
16			0.0933690	12.6868
	0.00000	1.90218		

THE RENOLDS NO. IS 0.57869086E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 24 .

AT 307.100 FEET, THE PRESSURE GRADIENT IS 0.009926 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	25.2520
2	0.48271	0.24510	0.012495	25.6318
3	0.47036	0.42516	0.022166	20.0539
4	0.42332	0.29605	0.034581	17.3800
5	0.43241	0.11532	0.045817	12.8992
6	0.41676	0.94506	0.020723	14.9937
7	0.39734	1.09971	0.028688	14.3389
8	0.37697	1.24340	0.064760	13.8899
9	0.32247	1.37308	0.070818	13.2283
10	0.33229	1.48825	0.076519	13.3083
11	0.30799	1.28934	0.080477	13.1181
12	0.28122	1.67207	0.084929	12.9739
13	0.22126	1.74609	0.088222	12.8920
14	0.21786	1.60322	0.090848	12.7849
15	0.17784	1.84718	0.092742	12.7296
16	0.12262	1.87692	0.093360	12.6998
	0.00000	1.40510		

THE RINGLOS NO. IS 0.2769086 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 409.500 FEET, THE PRESSURE GRADIENT IS 0.0009751 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48557	0.23954	0.0154927	30.6627
3	0.47035	0.43201	0.0251661	23.3338
4	0.45369	0.60666	0.0342811	19.8605
5	0.43595	0.77725	0.0428171	17.8854
6	0.41740	0.94453	0.0507523	16.6380
7	0.39802	1.10008	0.0580688	15.7943
8	0.37768	1.24232	0.0647604	15.1938
9	0.35618	1.37078	0.0708180	14.7510
10	0.33329	1.48505	0.0762199	14.4174
11	0.30868	1.58462	0.0809417	14.1641
12	0.28186	1.66894	0.0849569	13.9722
13	0.25215	1.73911	0.0882575	13.8275
14	0.21838	1.79596	0.0908484	13.7207
15	0.17828	1.83922	0.0927242	13.6469
16	0.12599	1.86900	0.0933690	13.5890
	0.00000	1.89481		

THE RENOLDS NO. IS 0.59085607E 03 .

THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 409.200 FEET, THE PRESSURE GRADIENT IS 0.0009751 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025728	20.0000
2	0.48221	0.23224	0.0124221	30.6621
3	0.47032	0.43201	0.021661	23.3338
4	0.42369	0.60666	0.0345811	19.8602
5	0.43292	0.71722	0.0429171	17.8824
6	0.41740	0.94423	0.0201223	16.6380
7	0.39802	1.10008	0.0280288	12.7443
8	0.37768	1.24232	0.0447604	12.1938
9	0.32618	1.37078	0.0708180	14.7210
10	0.33329	1.48202	0.0742139	14.4174
11	0.30868	1.28462	0.0809417	14.1941
12	0.28186	1.68894	0.0842269	13.0722
13	0.22212	1.73911	0.0882222	13.8222
14	0.21839	1.72296	0.0707484	13.7201
15	0.17828	1.83222	0.0227242	13.6429
16	0.12279	1.89400	0.0233990	13.2890
	0.00000	1.89481		

THE REYNOLDS NO. IS 0.290829076 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 26 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.0009414 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48509	0.23180	0.0154927	40.7947
3	0.46978	0.43945	0.0251661	29.8308
4	0.45343	0.62136	0.0342811	24.7317
5	0.43608	0.79382	0.0428171	21.8067
6	0.41783	0.95573	0.0507523	19.9505
7	0.39863	1.10604	0.0580688	18.6931
8	0.37839	1.24461	0.0647604	17.7969
9	0.35695	1.37022	0.0708180	17.1359
10	0.33408	1.48196	0.0762199	16.6387
11	0.30945	1.57904	0.0809417	16.2622
12	0.28260	1.66101	0.0849569	15.9767
13	0.25281	1.72993	0.0882575	15.7608
14	0.21894	1.78598	0.0908484	15.6012
15	0.17871	1.82881	0.0927242	15.4903
16	0.12624	1.85866	0.0933690	15.4015
	0.00000	1.88547		

THE RENOLDS NO. IS 0.61198454E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.009414 LBS/2 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025229	20.0000
2	0.48209	0.53180	0.0124952	40.2942
3	0.46418	0.43945	0.0251861	59.8309
4	0.44627	0.65136	0.0345811	54.2312
5	0.42836	0.29395	0.0458121	51.8022
6	0.41045	0.92223	0.0502523	19.9202
7	0.39254	1.10904	0.0580088	18.6931
8	0.37463	1.54461	0.0642604	12.2999
9	0.35672	1.32055	0.0208180	12.1329
10	0.33881	1.48196	0.0252199	19.6382
11	0.32090	1.52304	0.0809412	19.5955
12	0.30299	1.69101	0.0843299	12.9222
13	0.28508	1.25993	0.0885225	12.2908
14	0.26717	1.28290	0.0908484	12.6015
15	0.24926	1.85881	0.0925245	12.4903
16	0.23135	1.82896	0.0933690	12.4012
17	0.00000	1.88242		

THE REYNOLDS NO. IS 0.61198454E 03 .

THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 27 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0009226 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48465	0.22553	0.0154927	50.9730
3	0.46908	0.43591	0.0251661	36.2461
4	0.45273	0.62414	0.0342811	29.5381
5	0.43548	0.79829	0.0428171	25.6953
6	0.41732	0.96041	0.0507523	23.2514
7	0.39820	1.11073	0.0580688	21.5892
8	0.37803	1.24879	0.0647604	20.4010
9	0.35664	1.37390	0.0708180	19.5237
10	0.33381	1.48523	0.0762199	18.8639
11	0.30921	1.58175	0.0809417	18.3648
12	0.28238	1.66352	0.0849569	17.9860
13	0.25263	1.73273	0.0882575	17.6983
14	0.21880	1.78922	0.0908484	17.4854
15	0.17863	1.83251	0.0927242	17.3370
16	0.12625	1.86284	0.0933690	17.2162
	0.00000	1.89075		

THE RENOLDS NO. IS 0.62451542E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.000356 LBS/20 INCHES.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052528	20.0000
2	0.48462	0.55253	0.0124957	20.9730
3	0.46908	0.47291	0.0521661	36.5421
4	0.45373	0.65414	0.0345811	59.2381
5	0.43848	0.79829	0.0458171	55.6923
6	0.41735	0.96041	0.0507553	53.5214
7	0.39850	1.11073	0.0580688	51.2895
8	0.37803	1.24879	0.0647604	50.4010
9	0.35664	1.37390	0.0708180	49.2537
10	0.33381	1.48253	0.0752199	48.8939
11	0.30951	1.58175	0.0803414	48.3648
12	0.28538	1.66925	0.0844269	47.9890
13	0.25263	1.73573	0.0885275	47.6983
14	0.21880	1.78925	0.0908484	47.4824
15	0.17863	1.83521	0.0925245	47.3370
16	0.15952	1.86584	0.0933990	47.2195
	0.00000	1.89075		

THE REYNOLDS NO. IS 0.62421245E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 28 .

AT 1228.700 FEET, THE PRESSURE GRADIENT IS 0.0009017 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48420	0.21954	0.0154927	50.0000
3	0.46819	0.42527	0.0251661	49.1629
4	0.45158	0.62108	0.0342811	39.1333
5	0.43424	0.79761	0.0428171	33.4512
6	0.41604	0.96146	0.0507523	29.8328
7	0.39690	1.11345	0.0580688	27.3624
8	0.37672	1.25317	0.0647604	25.5918
9	0.35535	1.37984	0.0708180	24.2830
10	0.33254	1.49254	0.0762199	23.2992
11	0.30798	1.59018	0.0809417	22.5551
12	0.28120	1.67386	0.0849569	21.9882
13	0.25152	1.74518	0.0882575	21.5556
14	0.21780	1.80369	0.0908484	21.2345
15	0.17779	1.84864	0.0927242	21.0096
16	0.12567	1.88053	0.0933690	20.8222
	0.00000	1.91045		

THE RENOLDS NO. IS 0.63895058E 03 .

THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 28 .

AT 1528.700 FEET, THE PRESSURE GRADIENT IS 0.0009017 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025729	20.0000
2	0.48450	0.21924	0.0124457	20.0000
3	0.48819	0.42527	0.0221691	49.1659
4	0.42128	0.62108	0.0345811	39.1333
5	0.43454	0.79761	0.0458171	33.4215
6	0.41604	0.96149	0.0570523	29.8358
7	0.39690	1.11345	0.0580998	27.3954
8	0.37675	1.22317	0.0647604	22.2418
9	0.35232	1.37984	0.0708180	24.5830
10	0.33254	1.44254	0.0752199	23.5995
11	0.30728	1.29018	0.0804417	22.2221
12	0.28150	1.67386	0.0849269	21.9885
13	0.25152	1.74218	0.0885252	21.2229
14	0.21780	1.80399	0.0908484	21.5342
15	0.17779	1.84864	0.0927545	21.0039
16	0.15297	1.88023	0.0933990	20.8555
	0.00000	1.91042		

THE REYNOLDS NO. IS 0.63992028E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 29 .

AT 1638.300 FEET, THE PRESSURE GRADIENT IS 0.0008900 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	50.0000
	0.48394	0.21615		
2			0.0154927	50.0000
	0.46765	0.41854		
3			0.0251661	50.0000
	0.45077	0.61306		
4			0.0342811	48.7575
	0.43327	0.79526		
5			0.0428171	41.2030
	0.41499	0.96050		
6			0.0507523	36.4047
	0.39580	1.11322		
7			0.0580688	33.1227
	0.37557	1.25412		
8			0.0647604	30.7668
	0.35416	1.38240		
9			0.0708180	29.0237
	0.33133	1.49706		
10			0.0762199	27.7138
	0.30678	1.59702		
11			0.0809417	26.7220
	0.28003	1.68360		
12			0.0849569	25.9636
	0.25041	1.75748		
13			0.0882575	25.3831
	0.21680	1.81820		
14			0.0908484	24.9516
	0.17695	1.86493		
15			0.0927242	24.6482
	0.12505	1.89868		
16			0.0933690	24.3913
	0.00000	1.93062		

THE RENOLDS NO. IS 0.64734293E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 20 .

AT 1638.300 FEET, THE PRESSURE GRADIENT IS 0.0008900 LB\20 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CU FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025729	20.0000
2	0.48394	0.21612	0.0124427	20.0000
3	0.46762	0.41824	0.0221661	20.0000
4	0.42077	0.61306	0.0345811	20.0000
5	0.43327	0.79220	0.0458171	20.0000
6	0.41499	0.96020	0.0507253	20.0000
7	0.39280	1.11322	0.0507253	20.0000
8	0.37227	1.22412	0.0447604	20.0000
9	0.35416	1.30240	0.0308180	20.0000
10	0.33133	1.43706	0.0165199	20.0000
11	0.30678	1.52702	0.0009417	20.0000
12	0.28003	1.68360	0.0844269	20.0000
13	0.25041	1.72748	0.0882272	20.0000
14	0.21680	1.81820	0.0908484	20.0000
15	0.17692	1.96493	0.0925242	20.0000
16	0.12202	1.88868	0.0433600	20.0000
17	0.00000	1.93082		20.0000

THE REYNOLDS NO. IS 0.6434533E 03 .

THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 2457.500 FEET, THE PRESSURE GRADIENT IS 0.0008765 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48363	0.21222	0.0154927	50.0000
3	0.46702	0.41069	0.0251661	50.0000
4	0.44976	0.60029	0.0342811	50.0000
5	0.43185	0.78027	0.0428171	56.8088
6	0.41326	0.95351	0.0507523	49.5756
7	0.39391	1.11223	0.0580688	44.6414
8	0.37359	1.25621	0.0647604	41.1011
9	0.35211	1.38674	0.0708180	38.4782
10	0.32924	1.50463	0.0762199	36.5018
11	0.30468	1.60946	0.0809417	34.9989
12	0.27798	1.70126	0.0849569	33.8442
13	0.24849	1.77981	0.0882575	32.9585
14	0.21506	1.84458	0.0908484	32.2992
15	0.17549	1.89459	0.0927242	31.8327
16	0.12402	1.93161	0.0933690	31.4279
	0.00000	1.96708		

THE RENOLDS NO. IS 0.65735748E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 2427.200 FEET, THE PRESSURE GRADIENT IS 0.0008722 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	20.0000
2	0.48363	0.21552	0.0124452	20.0000
3	0.46702	0.41069	0.0221661	20.0000
4	0.44976	0.60029	0.0342811	20.0000
5	0.43182	0.78022	0.0458171	26.8088
6	0.41326	0.92321	0.0502523	49.2256
7	0.39391	1.11223	0.0280683	44.6414
8	0.37329	1.22621	0.0642604	41.1011
9	0.35211	1.38624	0.0708180	30.4182
10	0.32924	1.20463	0.0762199	36.2018
11	0.30468	1.60946	0.0809412	34.0080
12	0.27298	1.20126	0.0849299	33.8442
13	0.24849	1.22981	0.0882222	32.0282
14	0.21206	1.84428	0.0408484	32.2492
15	0.12249	1.80429	0.0222242	31.8322
16	0.12402	1.92161	0.0233690	31.4229
	0.00000	1.96208		

THE REYNOLDS NO. IS 0.6232246E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.0008696 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	50.0000
	0.48347	0.21021		
2			0.0154927	50.0000
	0.46669	0.40679		
3			0.0251661	50.0000
	0.44925	0.59458		
4			0.0342811	50.0000
	0.43114	0.77268		
5			0.0428171	50.0000
	0.41229	0.94072		
6			0.0507523	50.0000
	0.39262	1.09844		
7			0.0580688	56.1855
	0.37205	1.25052		
8			0.0647604	51.4194
	0.35044	1.38734		
9			0.0708180	47.8948
	0.32750	1.51029		
10			0.0762199	45.2338
	0.30293	1.61986		
11			0.0809417	43.2031
	0.27628	1.71596		
12			0.0849569	41.6395
	0.24689	1.79837		
13			0.0882575	40.4391
	0.21362	1.86651		
14			0.0908484	39.5451
	0.17426	1.91930		
15			0.0927242	38.9092
	0.12313	1.95905		
16			0.0933690	38.3479
	0.00000	1.99740		

THE RENOLDS NO. IS 0.66257145E 03 .

THE AGE OF FLOW IS 20.0003 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.000866 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025252	20.0000
2	0.48347	0.21051	0.0124951	20.0000
3	0.46669	0.40619	0.0251661	20.0000
4	0.44952	0.29458	0.0345811	20.0000
5	0.43114	0.17508	0.0458171	20.0000
6	0.41559	0.09015	0.0507253	20.0000
7	0.39565	1.09844	0.0280988	26.1822
8	0.37502	1.22025	0.0647604	21.4194
9	0.35044	1.38134	0.0708180	47.8948
10	0.32520	1.21059	0.0725199	42.5338
11	0.30533	1.61986	0.0509411	43.5031
12	0.27658	1.11268	0.0442699	41.6392
13	0.24699	1.79937	0.0825252	40.4391
14	0.21365	1.86921	0.0908484	39.2421
15	0.17456	1.91930	0.0921245	38.4092
16	0.15313	1.92902	0.0933600	38.3429
	0.00000	1.99740		

THE REYNOLDS NO. IS 0.6627142E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 32 .

AT 4915.100 FEET, THE PRESSURE GRADIENT IS 0.0008674 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1	0.48341	0.20963	0.0052759	50.0000
2	0.46658	0.40559	0.0154927	50.0000
3	0.44908	0.59280	0.0251661	50.0000
4	0.43091	0.77032	0.0342811	50.0000
5	0.41200	0.93779	0.0428171	50.0000
6	0.39225	1.09492	0.0507523	50.0000
7	0.37155	1.24143	0.0580688	50.0000
8	0.34974	1.37700	0.0647604	50.0000
9	0.32660	1.50133	0.0708180	50.0000
10	0.30182	1.61393	0.0762199	50.0000
11	0.27502	1.71764	0.0809417	59.5391
12	0.24557	1.80812	0.0849569	57.1175
13	0.21235	1.88311	0.0882575	55.2563
14	0.17315	1.94150	0.0908484	53.8701
15	0.12232	1.98617	0.0927242	52.8763
16	0.00000	2.02947	0.0933690	51.9797

THE RENOLDS NO. IS 0.66421258E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 4912.100 FEET, THE PRESSURE GRADIENT IS 0.000874 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.002529	20.0000
2	0.48341	0.20993	0.012427	20.0000
3	0.48828	0.40229	0.0221861	20.0000
4	0.44908	0.29280	0.0342811	20.0000
5	0.43091	0.27032	0.0428171	20.0000
6	0.41200	0.23779	0.0507253	20.0000
7	0.39222	1.09492	0.0586888	20.0000
8	0.37122	1.24143	0.0647004	20.0000
9	0.34974	1.37700	0.0708180	20.0000
10	0.32880	1.20133	0.0762199	20.0000
11	0.30182	1.81393	0.0809417	20.2391
12	0.27202	1.71794	0.0849289	22.1122
13	0.24221	1.80812	0.0882222	22.2222
14	0.21232	1.88311	0.0909484	23.8701
15	0.17312	1.94720	0.0927242	25.8293
16	0.12222	1.98917	0.0933990	27.9292
	0.00000	2.02947		

THE REYNOLDS NO. IS 0.9942528E 03 .

THE AGE OF FLOW IS 50.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 33 .

AT 6553.500 FEET, THE PRESSURE GRADIENT IS 0.0008683 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	50.0000
2	0.48344	0.20983	0.0154927	50.0000
3	0.46663	0.40609	0.0251661	50.0000
4	0.44915	0.59353	0.0342811	50.0000
5	0.43101	0.77130	0.0428171	50.0000
6	0.41212	0.93901	0.0507523	50.0000
7	0.39240	1.09639	0.0580688	50.0000
8	0.37174	1.24311	0.0647604	50.0000
9	0.34997	1.37892	0.0708180	50.0000
10	0.32687	1.50348	0.0762199	50.0000
11	0.30216	1.61632	0.0809417	50.0000
12	0.27541	1.71671	0.0849569	50.0000
13	0.24596	1.80391	0.0882575	50.0000
14	0.21270	1.87689	0.0908484	50.0000
15	0.17343	1.93412	0.0927242	50.0000
16	0.12247	1.97803	0.0933690	50.0000
	0.00000	2.02072		

THE RENOLDS NO. IS 0.66353555E 03 .



THE AGE OF FLOW IS 20.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 33 .

AT 6553.200 FEET, THE PRESSURE GRADIENT IS 0.000883 LB/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	20.0000
2	0.48344	0.20983	0.0124937	20.0000
3	0.46663	0.40209	0.021661	20.0000
4	0.44912	0.22323	0.0145811	20.0000
5	0.43101	0.17130	0.00458171	20.0000
6	0.41512	0.22901	0.0203253	20.0000
7	0.39540	1.09839	0.0280688	20.0000
8	0.37174	1.24311	0.0642904	20.0000
9	0.34997	1.37895	0.0708180	20.0000
10	0.32687	1.20348	0.0782199	20.0000
11	0.30516	1.61932	0.0809417	20.0000
12	0.27241	1.71671	0.0849569	20.0000
13	0.24296	1.80391	0.0825272	20.0000
14	0.21270	1.87289	0.0908484	20.0000
15	0.17343	1.92412	0.0925745	20.0000
16	0.12247	1.97803	0.0933990	20.0000
	0.00000	2.02072		

THE REYNOLDS NO. IS 0.6932222E 03 .



THE AGE OF FLOW IS 50.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)		PRESSURE (LB/SQ IN)
0.000		0.00000
0.100		0.00031
0.300		0.00092
0.700		0.00216
1.500		0.00462
3.100		0.00689
6.300		0.01035
12.700		0.01729
25.500		0.03096
51.100		0.05796
102.300		0.11159
204.700		0.21674
409.500		0.42063
819.100		0.80726
1638.300		1.54720
3276.700		2.98502
6553.500		5.82905
13107.100		11.51958
26214.300		22.90066
52428.699		45.66281
104857.498		91.18711
209715.096		182.23571
419430.293		364.33292
528000.000		458.60477

WITH 528000.0 FT., THE DROP IN PRESSURE IS 458.6048 LB/SQ IN.

THE AGE OF FLOW IS 20.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LB/20 IN)

0.0000	0.000
0.00031	0.100
0.00095	0.300
0.00218	0.700
0.00465	1.200
0.00689	3.100
0.01032	6.300
0.01529	12.700
0.03095	22.200
0.05796	21.100
0.11129	102.300
0.21674	504.700
0.45083	409.200
0.80726	819.100
1.24720	1638.300
2.28205	3276.700
2.82902	6553.200
11.21929	13107.100
22.90066	26214.300
42.06281	25428.699
91.18711	104827.498
182.23271	209712.096
364.33295	419430.293
428.00477	258000.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 428.0048 LB/20 IN.

THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 25 .

AT 409.500 FEET, THE PRESSURE GRADIENT IS 0.0009684 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	64.1110
	0.48610	0.24846		
2			0.0154927	30.4022
	0.47119	0.43428		
3			0.0251661	23.2938
	0.45461	0.60713		
4			0.0342811	19.8550
	0.43692	0.77651		
5			0.0428171	17.8901
	0.41838	0.94221		
6			0.0507523	16.6470
	0.39900	1.09621		
7			0.0580688	15.8052
	0.37863	1.23710		
8			0.0647604	15.2054
	0.35710	1.36437		
9			0.0708180	14.7628
	0.33416	1.47757		
10			0.0762199	14.4293
	0.30949	1.57621		
11			0.0809417	14.1760
	0.28261	1.65975		
12			0.0849569	13.9839
	0.25281	1.72935		
13			0.0882575	13.8390
	0.21895	1.78576		
14			0.0908484	13.7321
	0.17873	1.82869		
15			0.0927242	13.6581
	0.12626	1.85829		
16			0.0933690	13.6001
	0.00000	1.88404		

THE RENOLDS NO. IS 0.59493288E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 52 .

AT 400.500 FEET, THE PRESSURE GRADIENT IS 0.000984 LB\50 IN\FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT\SEC)	RADIAL INCREMENT FLOW (CU FT\SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.005529	64.1110
2	0.48810	0.54846	0.015495	30.4055
3	0.47119	0.43459	0.052166	53.5938
4	0.45481	0.60513	0.034581	19.8220
5	0.43695	0.77621	0.045817	17.8901
6	0.41830	0.94551	0.050553	16.6470
7	0.39900	1.09621	0.058088	15.8025
8	0.37863	1.23710	0.064704	15.5024
9	0.35710	1.36437	0.070818	14.7658
10	0.33416	1.47757	0.076519	14.4543
11	0.30949	1.57651	0.080917	14.1760
12	0.28501	1.66252	0.084969	13.9839
13	0.25581	1.73932	0.088525	13.8330
14	0.21892	1.78276	0.090864	13.7351
15	0.17870	1.85899	0.092554	13.6281
16	0.15656	1.92859	0.093360	13.6001
	0.00000	1.88404		

THE REYNOLDS NO. IS 0.2949388E 03 .

THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 26 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.0009325 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	90.3283
	0.48587	0.24465		
2			0.0154927	40.2356
	0.47098	0.44229		
3			0.0251661	29.7486
	0.45473	0.62123		
4			0.0342811	24.7156
	0.43742	0.79171		
5			0.0428171	21.8131
	0.41917	0.95146		
6			0.0507523	19.9674
	0.39995	1.09987		
7			0.0580688	18.7146
	0.37967	1.23670		
8			0.0647604	17.8205
	0.35817	1.36072		
9			0.0708180	17.1604
	0.33523	1.47102		
10			0.0762199	16.6636
	0.31051	1.56680		
11			0.0809417	16.2871
	0.28355	1.64772		
12			0.0849569	16.0015
	0.25363	1.71587		
13			0.0882575	15.7852
	0.21961	1.77131		
14			0.0908484	15.6254
	0.17917	1.81366		
15			0.0927242	15.5142
	0.12638	1.84324		
16			0.0933690	15.4250
	0.00000	1.86987		

THE RENOLDS NO. IS 0.61786775E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 614.300 FEET, THE PRESSURE GRADIENT IS 0.000935 LBS/20 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025129	30.3283
2	0.48287	0.24462	0.0124957	40.5322
3	0.47028	0.44529	0.0251991	50.7486
4	0.45473	0.65153	0.0345811	54.7126
5	0.43745	0.79771	0.0458171	51.8131
6	0.41917	0.92149	0.0507253	19.9674
7	0.39992	1.09987	0.0580288	18.7149
8	0.37967	1.23970	0.0647604	17.8502
9	0.35817	1.36075	0.0708190	17.1234
10	0.33253	1.47105	0.0765199	16.6636
11	0.31021	1.56980	0.0809417	16.5871
12	0.28922	1.66775	0.0849269	16.0012
13	0.25363	1.71283	0.0885272	12.7825
14	0.21991	1.77131	0.0908484	12.6524
15	0.17917	1.81366	0.0921545	12.5145
16	0.15638	1.84354	0.0933990	12.4520
	0.00000	1.89987		

THE REYNOLDS NO. IS 0.61789732 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 27 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.0009105 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	116.9320
	0.48579	0.24314		
2			0.0154927	50.0462
	0.47086	0.44195		
3			0.0251661	36.1239
	0.45468	0.62463		
4			0.0342811	29.5193
	0.43747	0.79521		
5			0.0428171	25.7100
	0.41930	0.95454		
6			0.0507523	23.2814
	0.40015	1.10242		
7			0.0580688	21.6260
	0.37991	1.23826		
8			0.0647604	20.4411
	0.35845	1.36132		
9			0.0708180	19.5654
	0.33553	1.47074		
10			0.0762199	18.9065
	0.31082	1.56556		
11			0.0809417	18.4077
	0.28386	1.64606		
12			0.0849569	18.0286
	0.25395	1.71431		
13			0.0882575	17.7405
	0.21994	1.77004		
14			0.0908484	17.5271
	0.17956	1.81275		
15			0.0927242	17.3783
	0.12690	1.84276		
16			0.0933690	17.2568
	0.00000	1.87062		

THE RENOLDS NO. IS 0.63277394E 03 .

THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 57 .

AT 819.100 FEET, THE PRESSURE GRADIENT IS 0.000105 LB/IN<sup>2</sup> IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025729	118.9350
2	0.48279	0.54314	0.0124457	50.0425
3	0.47086	0.44192	0.0521681	36.1539
4	0.45468	0.62463	0.0342811	59.2193
5	0.43747	0.79251	0.0428171	52.7100
6	0.41930	0.92424	0.0507253	53.2814
7	0.40012	1.10245	0.0586688	51.6520
8	0.37991	1.53856	0.0647604	50.4411
9	0.35842	1.36135	0.0708180	49.2224
10	0.33223	1.47074	0.0762199	48.9922
11	0.31085	1.26226	0.0909417	48.4077
12	0.28388	1.64606	0.0849269	48.0586
13	0.25392	1.71431	0.0825272	47.7402
14	0.21994	1.77004	0.0908484	47.2571
15	0.17926	1.81572	0.0957245	47.3783
16	0.15690	1.84576	0.0933690	47.2229
	0.00000	1.87065		

THE REYNOLDS NO. IS 0.6327394E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 28 .

AT 1228.700 FEET, THE PRESSURE GRADIENT IS 0.0008826 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	170.8321
2	0.48566	0.24101	0.0154927	69.7578
3	0.47069	0.44279	0.0251661	48.8527
4	0.45453	0.62625	0.0342811	39.1048
5	0.43734	0.79555	0.0428171	33.4996
6	0.41916	0.95412	0.0507523	29.9111
7	0.39998	1.10177	0.0580688	27.4530
8	0.37972	1.23767	0.0647604	25.6876
9	0.35823	1.36090	0.0708180	24.3809
10	0.33527	1.47045	0.0762199	23.3982
11	0.31053	1.56531	0.0809417	22.6537
12	0.28354	1.64711	0.0849569	22.0852
13	0.25361	1.71686	0.0882575	21.6508
14	0.21961	1.77408	0.0908484	21.3283
15	0.17925	1.81804	0.0927242	21.1020
16	0.12667	1.84963	0.0933690	20.9124
	0.00000	1.87946		

THE RENOLDS NO. IS 0.65276529E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 50 .

AT 1558.700 FEET, THE PRESSURE GRADIENT IS 0.000858 LBS/20 INCHES.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	170.8351
2	0.48566	0.24101	0.0124953	69.7278
3	0.47089	0.44519	0.0251661	48.8252
4	0.42423	0.62522	0.0345811	39.1048
5	0.43734	0.73222	0.0458171	33.4937
6	0.41916	0.92412	0.0507253	29.9111
7	0.39998	1.10117	0.0580688	27.4230
8	0.37912	1.23767	0.0647604	25.6676
9	0.35853	1.36090	0.0708180	24.3809
10	0.33252	1.47042	0.0752199	23.3985
11	0.31023	1.56231	0.0789417	22.6232
12	0.28324	1.64111	0.0849269	22.0822
13	0.25361	1.71686	0.0925212	21.6202
14	0.21961	1.77408	0.0996484	21.3283
15	0.17922	1.81804	0.0952545	21.1050
16	0.12692	1.84963	0.0933690	20.9154
	0.00000	1.87946		

THE REYNOLDS NO. IS 0.62276253E 03 .

THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 29 .

AT 1638.300 FEET, THE PRESSURE GRADIENT IS 0.0008631 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48551	0.23664	0.0154927	89.5252
3	0.47051	0.44236	0.0251661	61.5347
4	0.45442	0.62702	0.0342811	48.6586
5	0.43729	0.79645	0.0428171	41.2769
6	0.41915	0.95277	0.0507523	36.5407
7	0.39996	1.09843	0.0580688	33.2842
8	0.37966	1.23335	0.0647604	30.9389
9	0.35812	1.35639	0.0708180	29.2005
10	0.33512	1.46635	0.0762199	27.8924
11	0.31033	1.56235	0.0809417	26.8993
12	0.28331	1.64605	0.0849569	26.1374
13	0.25339	1.71754	0.0882575	25.5535
14	0.21942	1.77631	0.0908484	25.1193
15	0.17914	1.82156	0.0927242	24.8132
16	0.12672	1.85483	0.0933690	24.5515
	0.00000	1.88676		

THE RENOLDS NO. IS 0.66752172E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 29 .

AT 1638.500 FEET, THE PRESSURE GRADIENT IS 0.0008931 LB/50 INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	500.0000
2	0.48251	0.23284	0.0124925	89.2525
3	0.47021	0.44539	0.0251661	61.2345
4	0.42445	0.65705	0.0345811	48.6289
5	0.43759	0.79845	0.0458171	41.2599
6	0.41915	0.92517	0.0507253	36.2407
7	0.39999	1.09843	0.0580988	33.2845
8	0.37966	1.23335	0.0647604	30.9389
9	0.35815	1.32639	0.069180	29.2002
10	0.33515	1.46935	0.0725199	27.8554
11	0.31033	1.56535	0.0809411	26.8993
12	0.28331	1.64805	0.0844569	26.1354
13	0.25339	1.71754	0.0885252	25.2532
14	0.21945	1.77631	0.0908484	25.1133
15	0.17914	1.82159	0.0925245	24.8135
16	0.12675	1.85483	0.0933690	24.2515
	0.00000	1.88656		

THE REYNOLDS NO. IS 0.66725152 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 2457.500 FEET, THE PRESSURE GRADIENT IS 0.0008341 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48499	0.23065	0.0154927	129.4989
3	0.46969	0.44112	0.0251661	86.8686
4	0.45355	0.62980	0.0342811	67.7032
5	0.43646	0.80108	0.0428171	56.7898
6	0.41837	0.95825	0.0507523	49.7853
7	0.39923	1.10284	0.0580688	44.9505
8	0.37894	1.23561	0.0647604	41.4547
9	0.35737	1.35689	0.0708180	38.8531
10	0.33431	1.46677	0.0762199	36.8869
11	0.30947	1.56491	0.0809417	35.3853
12	0.28243	1.65112	0.0849569	34.2268
13	0.25251	1.72501	0.0882575	33.3368
14	0.21856	1.78598	0.0908484	32.6739
15	0.17834	1.83303	0.0927242	32.2022
16	0.12599	1.86903	0.0933690	31.7860
	0.00000	1.90407		

THE RENOLDS NO. IS 0.69071072E 03 .

THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 5457.500 FEET, THE PRESSURE GRADIENT IS 0.0008341 LBS/20 INCHES.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0025259	500.0000
2	0.48499	0.53082	0.0124457	129.4999
3	0.46999	0.44115	0.0521661	89.8999
4	0.45322	0.65980	0.0345811	67.1033
5	0.43646	0.80108	0.0458171	50.7999
6	0.41837	0.92852	0.0501523	40.7823
7	0.39923	1.10594	0.0780688	44.4502
8	0.37894	1.23291	0.0641604	41.4547
9	0.35737	1.32689	0.0708180	38.8231
10	0.33431	1.46677	0.0765199	36.8899
11	0.30947	1.56491	0.0809417	32.3823
12	0.28243	1.62115	0.0849299	34.5529
13	0.25251	1.75201	0.0885212	33.3399
14	0.21829	1.78298	0.0908484	35.6134
15	0.17834	1.83703	0.0925245	35.5055
16	0.15299	1.86903	0.0933990	31.7890
	0.00000	1.90407		

THE REYNOLDS NO. IS 0.69071052E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.0008132 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48459	0.22479	0.0154927	170.2575
3	0.46897	0.43522	0.0251661	112.3597
4	0.45265	0.62721	0.0342811	86.7527
5	0.43548	0.80134	0.0428171	72.2735
6	0.41736	0.96037	0.0507523	62.9993
7	0.39820	1.10613	0.0580688	56.5966
8	0.37791	1.23974	0.0647604	51.9590
9	0.35633	1.36183	0.0708180	48.4963
10	0.33327	1.47263	0.0762199	45.8665
11	0.30844	1.57190	0.0809417	43.8479
12	0.28140	1.65935	0.0849569	42.2856
13	0.25151	1.73453	0.0882575	41.0832
14	0.21760	1.79675	0.0908484	40.1870
15	0.17740	1.84489	0.0927242	39.5437
16	0.12506	1.88293	0.0933690	38.9619
	0.00000	1.92022		

THE RENOLDS NO. IS 0.70850658E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 31 .

AT 3276.700 FEET, THE PRESSURE GRADIENT IS 0.0008135 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	500.0000
2	0.48429	0.22419	0.0124921	170.2222
3	0.46897	0.43222	0.0221661	112.3297
4	0.42262	0.62121	0.0342811	86.1222
5	0.43248	0.80134	0.0428171	72.2222
6	0.41736	0.96037	0.0501223	62.9997
7	0.39820	1.10613	0.0580688	56.2990
8	0.37791	1.23974	0.0647604	51.9220
9	0.35633	1.36183	0.0708180	48.4997
10	0.33327	1.47263	0.0762199	45.8622
11	0.30844	1.57190	0.0809417	43.8473
12	0.28140	1.65932	0.0844269	42.2029
13	0.25121	1.73423	0.0865272	41.0932
14	0.21760	1.79672	0.0884844	40.1870
15	0.17740	1.84489	0.0892242	39.2637
16	0.12206	1.88293	0.0893390	38.9919
	0.00000	1.92022		

THE REYNOLDS NO. IS 0.70820628E 03 .

THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 32 .

AT 4915.100 FEET, THE PRESSURE GRADIENT IS 0.0007875 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48409	0.21755	0.0154927	200.0000
3	0.46806	0.42321	0.0251661	164.4254
4	0.45147	0.61732	0.0342811	125.3000
5	0.43413	0.79614	0.0428171	103.4086
6	0.41594	0.95980	0.0507523	89.4657
7	0.39678	1.10942	0.0580688	79.8632
8	0.37652	1.24605	0.0647604	72.9088
9	0.35501	1.37037	0.0708180	67.7053
10	0.33204	1.48286	0.0762199	63.7360
11	0.30732	1.58372	0.0809417	60.6729
12	0.28042	1.67278	0.0849569	58.2936
13	0.25069	1.74971	0.0882575	56.4577
14	0.21702	1.81378	0.0908484	55.0869
15	0.17716	1.86376	0.0927242	54.0880
16	0.12545	1.90551	0.0933690	53.1532
	0.00000	1.94724		

THE RENOLDS NO. IS 0.73157812E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 4915.100 FEET, THE PRESSURE GRADIENT IS 0.0007875 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025129	500.0000
2	0.48409	0.21752	0.0124951	500.0000
3	0.46806	0.45351	0.0521661	164.4524
4	0.45147	0.61735	0.0345811	152.3000
5	0.43413	0.79614	0.0458171	103.4084
6	0.41594	0.92980	0.0507553	89.4651
7	0.39678	1.10945	0.0580688	79.8635
8	0.37655	1.34605	0.0641604	75.9088
9	0.35501	1.63703	0.0708180	67.7053
10	0.33204	1.98586	0.0765199	63.7390
11	0.30735	1.28375	0.0809411	60.9159
12	0.28045	1.67578	0.0842569	58.5936
13	0.25069	1.74971	0.0885252	56.4511
14	0.21705	1.81378	0.0908484	55.0829
15	0.17716	1.86376	0.0921545	54.0880
16	0.15245	1.90521	0.0933690	53.1235
	0.00000	1.94754		

THE REYNOLDS NO. IS 0.73151815E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 33 .

AT 6553.500 FEET, THE PRESSURE GRADIENT IS 0.0007722 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	200.0000
	0.48374	0.21357		
2			0.0154927	200.0000
	0.46729	0.41569		
3			0.0251661	200.0000
	0.45030	0.61004		
4			0.0342811	163.9939
	0.43269	0.79191		
5			0.0428171	134.4924
	0.41434	0.95918		
6			0.0507523	115.8033
	0.39509	1.11222		
7			0.0580688	102.9762
	0.37480	1.25164		
8			0.0647604	93.7028
	0.35328	1.37824		
9			0.0708180	86.7639
	0.33033	1.49291		
10			0.0762199	81.4603
	0.30564	1.59581		
11			0.0809417	77.3562
	0.27880	1.68681		
12			0.0849569	74.1613
	0.24914	1.76549		
13			0.0882575	71.6913
	0.21554	1.83116		
14			0.0908484	69.8439
	0.17576	1.88265		
15			0.0927242	68.4792
	0.12412	1.92755		
16			0.0933690	67.1659
	0.00000	1.97189		

THE RENOLDS NO. IS 0.74611302E 03 .

THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 33 .

AT 6523.200 FEET, THE PRESSURE GRADIENT IS 0.000755 LB/IN<sup>2</sup> INVERT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	500.0000
2	0.48374	0.51357	0.0124957	500.0000
3	0.46759	0.41569	0.0251661	500.0000
4	0.42030	0.61004	0.0345811	163.9439
5	0.43269	0.70191	0.0458171	134.4954
6	0.41434	0.92918	0.0507553	115.8033
7	0.39209	1.11555	0.0580688	105.9165
8	0.37480	1.52164	0.0647904	93.7058
9	0.35358	1.37854	0.0709180	86.7639
10	0.33033	1.44591	0.0765199	81.4603
11	0.30264	1.59281	0.0809417	77.3225
12	0.27880	1.68681	0.0849269	74.1613
13	0.24914	1.76549	0.0885252	71.9913
14	0.21254	1.83119	0.0908484	69.8439
15	0.17276	1.88565	0.0925245	68.4795
16	0.15415	1.92525	0.0933990	67.1659
	0.00000	1.97189		

THE REYNOLDS NO. IS 0.7461305E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 34 .

AT 9830.300 FEET, THE PRESSURE GRADIENT IS 0.0007545 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
	0.50000	0.00000		
1			0.0052759	200.0000
	0.48335	0.20871		
2			0.0154927	200.0000
	0.46649	0.40607		
3			0.0251661	200.0000
	0.44905	0.59597		
4			0.0342811	200.0000
	0.43101	0.77765		
5			0.0428171	197.1403
	0.41232	0.94997		
6			0.0507523	168.5980
	0.39285	1.10910		
7			0.0580688	149.1182
	0.37244	1.25464		
8			0.0647604	135.0924
	0.35088	1.38689		
9			0.0708180	124.6164
	0.32794	1.50646		
10			0.0762199	116.6045
	0.30332	1.61356		
11			0.0809417	110.3937
	0.27659	1.70820		
12			0.0849569	105.5505
	0.24708	1.79014		
13			0.0882575	101.7993
	0.21369	1.85883		
14			0.0908484	98.9843
	0.17419	1.91375		
15			0.0927242	96.8581
	0.12298	1.96360		
16			0.0933690	94.7399
	0.00000	2.01279		

THE RENOLDS NO. IS 0.76367079E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 34 .

AT 9830.300 FEET, THE PRESSURE GRADIENT IS 0.0007242 LB/250 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	500.0000
2	0.48332	0.20871	0.0124927	500.0000
3	0.46849	0.40807	0.0221661	500.0000
4	0.44902	0.22297	0.0342811	500.0000
5	0.43101	0.17762	0.0428171	197.1403
6	0.41532	0.24997	0.0207223	188.2080
7	0.39282	1.10910	0.0280888	149.1182
8	0.37244	1.22464	0.0647604	132.0324
9	0.32088	1.38889	0.0708180	124.6164
10	0.32794	1.20646	0.0762199	116.8042
11	0.30332	1.61326	0.0809417	110.3937
12	0.27629	1.70820	0.0849269	102.2202
13	0.24708	1.79014	0.0882222	101.7993
14	0.21369	1.82883	0.0908484	98.4843
15	0.17419	1.91322	0.0925242	96.8281
16	0.12298	1.99390	0.0933990	94.7399
	0.00000	2.01210		

THE REYNOLDS NO. IS 0.78367074E 03 .

THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 13107.100 FEET, THE PRESSURE GRADIENT IS 0.0007447 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48313	0.20603	0.0154927	200.0000
3	0.46603	0.40076	0.0251661	200.0000
4	0.44833	0.58807	0.0342811	200.0000
5	0.43002	0.76722	0.0428171	200.0000
6	0.41102	0.93785	0.0507523	200.0000
7	0.39127	1.09962	0.0580688	195.3452
8	0.37065	1.25143	0.0647604	176.3652
9	0.34897	1.38959	0.0708180	162.2335
10	0.32599	1.51449	0.0762199	151.4418
11	0.30138	1.62640	0.0809417	143.0790
12	0.27472	1.72533	0.0849569	136.5572
13	0.24533	1.81108	0.0882575	131.5025
14	0.21210	1.88310	0.0908484	127.6981
15	0.17284	1.94119	0.0927242	124.7773
16	0.12199	1.99495	0.0933690	121.8083
	0.00000	2.04789		

THE RENOLDS NO. IS 0.77371173E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 35 .

AT 13107.100 FEET, THE PRESSURE GRADIENT IS 0.0007447 LBS/20 INCHES.

RADIAL INCREMENT NO.	RADIUS (FEET)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025259	500.0000
2	0.48313	0.20203	0.0124951	500.0000
3	0.46603	0.40016	0.0251691	500.0000
4	0.44833	0.28803	0.0345811	500.0000
5	0.43005	0.18755	0.0458171	500.0000
6	0.41105	0.23785	0.0570253	500.0000
7	0.39151	1.00005	0.0280988	132.3425
8	0.37065	1.25143	0.0647604	126.3625
9	0.34897	1.38029	0.0708180	165.2335
10	0.32599	1.21449	0.0745199	121.4418
11	0.30138	1.05640	0.0700411	143.0130
12	0.27415	1.15233	0.0842599	136.2525
13	0.24233	1.81108	0.0885252	131.2052
14	0.21510	1.88310	0.0908484	151.6981
15	0.17584	1.94119	0.0925245	154.7173
16	0.15199	1.99492	0.0933990	151.8087
	0.00000	2.04189		

THE REYNOLDS NO. IS 0.7737173E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 36 .

AT 19660.700 FEET, THE PRESSURE GRADIENT IS 0.0007381 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48297	0.20428	0.0154927	200.0000
3	0.46572	0.39720	0.0251661	200.0000
4	0.44784	0.58279	0.0342811	200.0000
5	0.42934	0.76023	0.0428171	200.0000
6	0.41013	0.92915	0.0507523	200.0000
7	0.39014	1.08925	0.0580688	200.0000
8	0.36925	1.24015	0.0647604	200.0000
9	0.34732	1.38103	0.0708180	200.0000
10	0.32411	1.51131	0.0762199	200.0000
11	0.29936	1.63041	0.0809417	207.9376
12	0.27263	1.73836	0.0849569	197.9046
13	0.24329	1.83232	0.0882575	190.1340
14	0.21021	1.91108	0.0908484	184.2723
15	0.17121	1.97471	0.0927242	179.6846
16	0.12080	2.03452	0.0933690	174.9174
	0.00000	2.09336		

THE RENOLDS NO. IS 0.78059609E 03 .

THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 30 .

AT 19880.700 FEET, THE PRESSURE GRADIENT IS 0.0007381 LB/20 IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	500.0000
2	0.48297	0.20458	0.0124927	500.0000
3	0.46272	0.39750	0.0221661	500.0000
4	0.44784	0.28579	0.0345811	500.0000
5	0.45234	0.16053	0.0458171	500.0000
6	0.41013	0.92912	0.0207253	500.0000
7	0.39014	1.08929	0.0280688	500.0000
8	0.36922	1.24012	0.0447604	500.0000
9	0.34732	1.38103	0.0708180	500.0000
10	0.32411	1.21131	0.0782199	500.0000
11	0.29936	1.63041	0.0809417	507.9379
12	0.27563	1.73836	0.0849269	197.9046
13	0.24329	1.83232	0.0882272	190.1340
14	0.21021	1.91108	0.0908484	184.2573
15	0.17121	1.97471	0.0927242	179.6446
16	0.12080	2.03422	0.0933690	174.9174
	0.00000	2.09336		

THE REYNOLDS NO. IS 0.78029609E 03 .



THE AGE OF FLOW IS 200.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 37 .

AT 26214.300 FEET, THE PRESSURE GRADIENT IS 0.0007379 LB/SQ IN/FT.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.50000	0.00000	0.0052759	200.0000
2	0.48297	0.20420	0.0154927	200.0000
3	0.46571	0.39712	0.0251661	200.0000
4	0.44783	0.58266	0.0342811	200.0000
5	0.42932	0.76006	0.0428171	200.0000
6	0.41011	0.92896	0.0507523	200.0000
7	0.39011	1.08902	0.0580688	200.0000
8	0.36922	1.23987	0.0647604	200.0000
9	0.34727	1.38071	0.0708180	200.0000
10	0.32406	1.51094	0.0762199	200.0000
11	0.29929	1.62999	0.0809417	200.0000
12	0.27254	1.73711	0.0849569	200.0000
13	0.24317	1.83132	0.0882575	200.0000
14	0.21007	1.91130	0.0908484	200.0000
15	0.17106	1.97646	0.0927242	200.0000
16	0.12065	2.03817	0.0933690	200.0000
	0.00000	2.09927		

THE RENOLDS NO. IS 0.78076582E 03 .



THE AGE OF FLOW IS 500.0000 MIN.

THE INCREMENT NUMBER IN LENGTH IS 37 .

AT 56514.300 FEET, THE PRESSURE GRADIENT IS 0.0007379 LB/IN<sup>2</sup> INCH.

RADIAL INCREMENT NO.	RADIUS (FT)	VELOCITY (FT/SEC)	RADIAL INCREMENT FLOW (CU FT/SEC)	AGE AT CENTRE OF INCREMENT (MIN)
1	0.20000	0.00000	0.0025229	500.0000
2	0.48297	0.50450	0.0124957	500.0000
3	0.46271	0.39715	0.0521661	500.0000
4	0.44783	0.28566	0.0345811	500.0000
5	0.45235	0.16006	0.0458171	500.0000
6	0.41011	0.25828	0.0507523	500.0000
7	0.39011	1.08405	0.0580688	500.0000
8	0.36955	1.53987	0.0647604	500.0000
9	0.34757	1.38071	0.0708180	500.0000
10	0.35406	1.21034	0.0765199	500.0000
11	0.50259	1.65299	0.0809417	500.0000
12	0.57524	1.13711	0.0849269	500.0000
13	0.54317	1.83135	0.0885252	500.0000
14	0.51007	1.91130	0.0908484	500.0000
15	0.17106	1.27646	0.0957545	500.0000
16	0.15065	5.03817	0.0933890	500.0000
	0.00000	5.09257		

THE REYNOLDS NO. IS 0.7807685E 03 .

THE AGE OF FLOW IS 200.0000 MIN.

DISTANCE FROM ENTRANCE  
(FEET)

PRESSURE  
(LB/SQ IN)

0.000	0.00000
0.100	0.00031
0.300	0.00092
0.700	0.00216
1.500	0.00462
3.100	0.00689
6.300	0.01035
12.700	0.01729
25.500	0.03096
51.100	0.05796
102.300	0.11159
204.700	0.21674
409.500	0.42041
819.100	0.80331
1638.300	1.52750
3276.700	2.89636
6553.500	5.48262
13107.100	10.43569
26214.300	20.12402
52428.699	39.46849
104857.498	78.15741
209715.096	155.53527
419430.293	310.29098
528000.000	390.40812

WITH 528000.0 FT., THE DROP IN PRESSURE IS 390.4081 LB/SQ IN.

THE AGE OF FLOW IS 500.0000 MIN.

DISTANCE FROM ENTRANCE (FEET)  
PRESSURE (LB/IN)

0.0000	0.000
0.00031	0.100
0.00095	0.300
0.00516	0.700
0.00465	1.500
0.00689	3.100
0.01035	6.300
0.01750	15.700
0.03096	52.500
0.05796	21.100
0.11159	105.300
0.21674	504.700
0.45041	409.500
0.80331	819.100
1.25750	1638.300
5.89936	3276.700
2.48565	6553.500
10.43569	13107.100
50.15405	56514.300
34.46849	25458.699
78.15741	104857.498
152.53557	509715.098
310.59098	419430.593
390.40815	258000.000

WITH 258000.0 FT., THE DROP IN PRESSURE IS 390.4081 LB/IN.











**B29851**